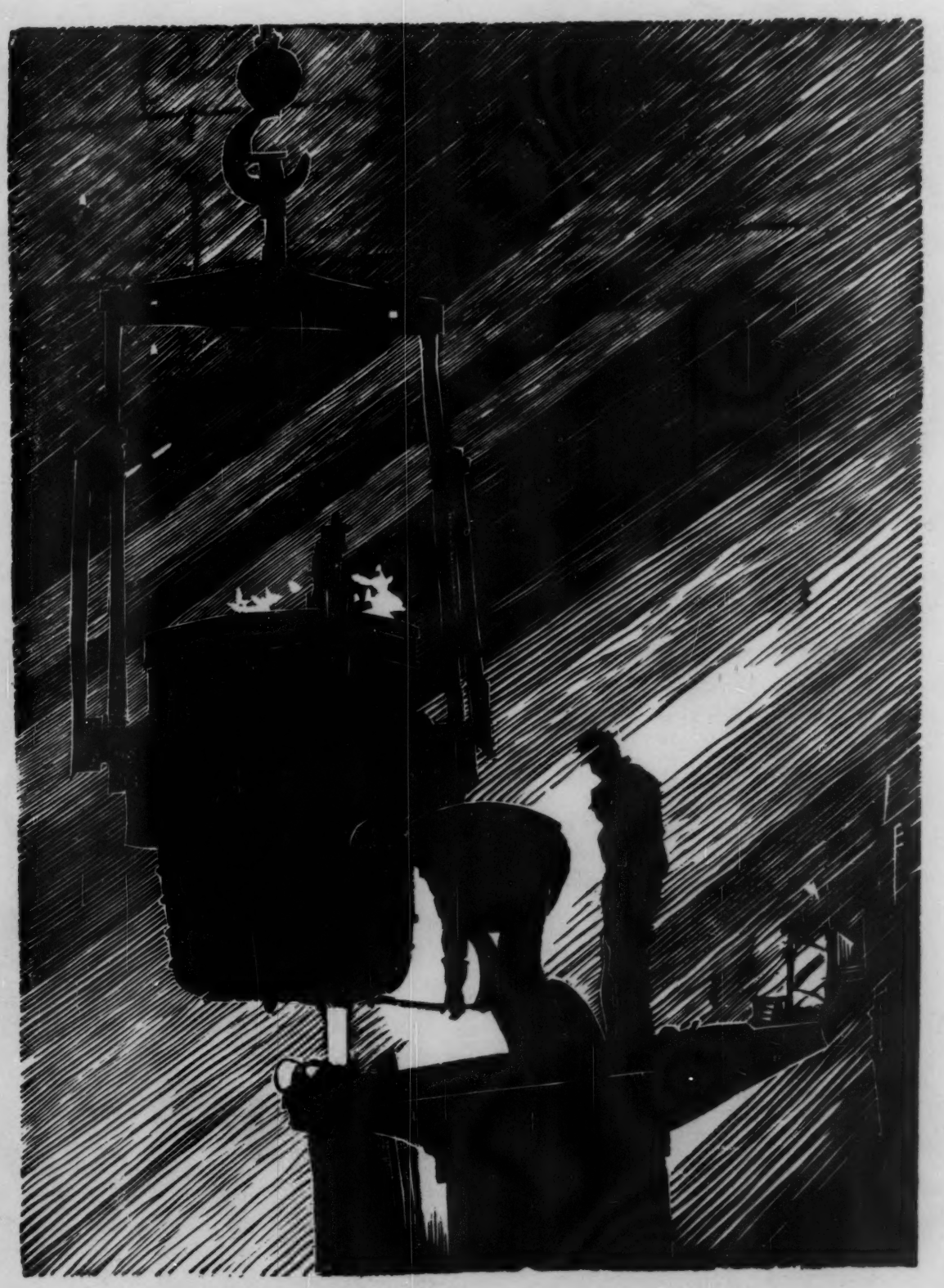
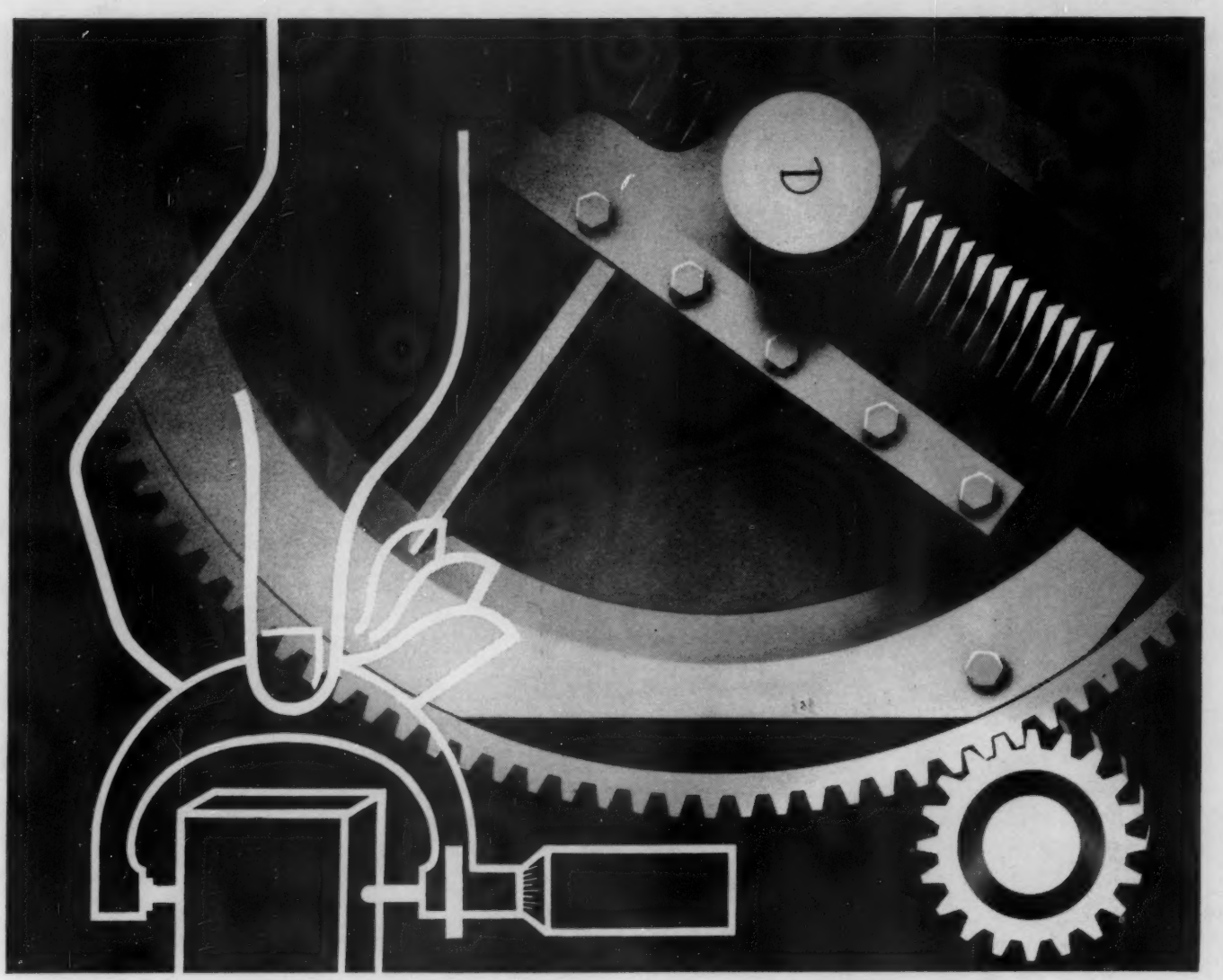
THE TECH ENGINEERING NEWS

Massachusetts Institute of Technology • 1938 • *April*





PRECISION

IT TAKES a precise machine to turn out precise work. And if its vital parts are made of Moly irons or steels, the longer maintenance of its precision is assured. Shapers, for instance.

One company building such machines uses 0.50% Mo, Nickel-Moly iron for main and intermediary gears in the power transmission system. This iron is used because *it possesses the wear resistance which preserves the close tolerances necessary to prevent "chattering."* Also—because it machines readily despite its comparatively high hardness.

Thus, the use of Moly brings advantages: (a) to the builder of the machines through simpler and more economical fabrication; (b) to the user through better performance due to longer maintained precision; (c) to the user's customers through better products.

Our technical book, *"Molybdenum in Cast Iron,"* contains money-saving data. Free to engineers and production executives. Drop us a card and we will send it to you. Climax Molybdenum Company, 500 Fifth Avenue, New York City.

PRODUCERS OF FERRO-MOLYBDENUM, CALCIUM MOLYBDATE AND MOLYBDENUM TRIOXIDE

Climax Mo-lyb-den-um Company

MOLY

OUR AUTHORS

ROBERT HUTCHINGS GODDARD has undertaken extensive researches upon the rocket method of reaching extreme altitudes, and is better qualified, probably, than anyone else to write "Some Aspects of Rocket Engineering." He received his elementary training in science at Worcester Polytechnic Institute, and later did graduate work at Clark University, where, at present, he is a professor of physics. During the World War he was Director of Research in the United States Signal Corps, and also Director of the Mt. Wilson Observatory in California.

HOWARD COREY LAWRENCE, JR., '38, is studying electrical communication engineering at Massachusetts Institute of Technology. Mr. Lawrence has devoted much time to experimenting with television equipment, and in keeping himself well informed on television technique, and is considered to be among those most advanced in this subject at the Institute. He graduated from Montclair, New Jersey, High School in 1934. He is the operator of radio amateur station W2IUP. For his senior thesis subject he has chosen the design and construction of a low cost television eceiver. He wrote "Electronic Television."

JOHAM ADAM BERTSCH is the American chemist whom the German government requested to submit his opinion of the cause of the recent *Hindenburg* disaster. Dr. Bertsch was born in Darmstadt, Germany, and studied there at the Technische Hochschule. He worked, for a short while, with the I. G. Dye Trust in Germany, and then came to the United States, in 1924. Dr. Bertsch is now associated with the Monsanto Chemical Co. in St. Louis, Mo., as a catalysis expert, and has written "The Four-Year Plan in Germany," now appearing in the TECH ENGINEERING NEWS.

E. B. RIDEOUT is a commercial meteorologist and at present is employed by radio station WEEI, in Boston, as a weather forecaster. As there were no schools presenting courses when Mr. Rideout first became interested in weather thirty years ago, he was compelled to gain a formal education in meteorology from information acquired in reading textbooks, and through experimentation. He has served with the United States Weather Bureau and has written the article on "Weather Forecasting in Industry."

PREVIEWS

MANY OF US around the Institute have gazed at the construction going on in erecting the new Architectural Building at Technology, and have listened to the rumors circulating about its unique design. Mr. E. A. Dockstader, of the Stone and Webster Co., the contractors engaged in the construction of the building, writes in a future issue of the TECH ENGINEERING NEWS, and tells of the many new methods incorporated in the design of the building.

With the more complicated steel structures being erected today, it is quite essential for the designer to know accurately the conditions of stress that exist in them. Dr. William M. Murray, of the Mechanical Engineering Department at Massachusetts Institute of Technology, describes in the next issue the applications of photoelasticity in determining stress conditions in structures, where mathematical analysis would be difficult or impossible.

Physics
Chemistry
Mathematics
Thermodynamics
Applied Mechanics
Electrical Engineering
Entrance Physics and Mathematics

THE ASSOCIATED TUTORS

410 Memorial Drive, Cambridge

Kirkland 4990 A. L. M. Dingee, Director

EXPERT INSTRUCTION—EXPERIENCED TUTORS

BERKELEY PREPARATORY SCHOOL

(Established 1907)

An Accredited School

Preparation for all colleges and technical schools; entrance by certificate or examination

Day and Evening Sessions

SEND FOR CATALOG

HARRY F. CADE, JR. (M. I. T. '28) Headmaster

1089 BOYLSTON STREET, BOSTON Telephone Commonwealth 9262

WELDING is responsible for a majority of the streamliners now racing about the country. Burlington's Zephyrs, the Boston & Maine's Flying Yankee—all made of stainless steel—and the Pennsylvania's new super-electric locomotives, all owe their form and much of their efficiency to welding. Welding makes possible tremendous savings in weight without sacrificing strength and rigidity.

Streamlining . . .

Demands smooth, unbroken surface and strong, light frames—both attained by welding

"STREAMLINING" is more than a word to catch popular fancy and assure sales. This design trend, in automobiles, trains, ships and a vast variety of equipment items, has several extremely sound reasons for existence. Smooth mass-distribution and unbroken surfaces mean ease of operation and savings in power for moving objects. This smoothness of design also results in easier handling of portable objects, as well as cleanliness, simplicity and efficiency.

Streamlining involves the method of construction, the theory behind the design. Streamlined articles are unit-built of strong, light materials. The entire product is designed to be one-piece and to develop the maximum strength of each individual member with the minimum of added weight.

Welding is the most practical, least expensive and surest means of attaining permanent strength in metal fabrication. A welded article is a single unit when assembled, and always remains so. There are no mechanical joints to jolt, jar or work loose with the passage of time. Various members can be depended upon to develop their full, assigned reactions now or ten years from now. Welded construction, therefore, means more than adequate economy in design and construction. It means confidence in the permanence and adequacy of the product.

Welding allows the designer to specify any shape or combination of shapes without limitation. By welding, complex forms can be built up from simple units. Metal can be cut away or added. Projections, lugs, ears, rods, bars, any member —can be added to the foundation. Dissimilar metals can be joined. Long-wearing or corrosion-resistant alloys can be used to reinforce or build up at sections subject to special wear or abrasion.

In fact, welding relieves the designer of many limitations, of most of the old inhibitions and joint problems of old-fashioned design. It makes possible the fabrication of a better, more serviceable, longer-lived product at lower cost. The essential advantages of modern design are obtained by welding with convenience, economy and assurance.

Welding Savings

The New Haven "Comet" uses cromansil steel engine beds and car trucks, all welded. Cromansil, a high-tensile mild-alloy steel containing chromium, manganese and silicon, was chosen as best for high-strength, rigid members. Welding was specified because it develops the full strength with minimum weight.

* * *

Stands for automatic vending machines are now stronger, better, more permanent. They used to be made by screwing lengths of 1½-inch pipe into cast iron bases. They are now bronze-welded at less cost with obvious improvement in strength, durability and ease of fabrication.

* * *

Welding makes stainless steel beer barrels practical. Strong, light, smooth inside and out, these barrels have no crevices or corners in which fungi and bacteria can breed. Welding makes them all one-piece and prevents bacterial and mold action and chemical off-tastes. Further, because of welding, they outlast all others.

* * *

Welding produces gas-operated refrigerators at a reasonable production cost. After making exhaustive tests involving every method of fabrication possible, the manufacturer standardized on welding 100 per cent. Results include a better product, more flexibility in design and lower manufacturing costs.

* * *

Welding makes modern metal furniture production possible. Faced with tremendous competition, this new industry capitalized the advantages of welding in the production of light, strong, modern designs and has grown to a sound and healthy state. Welding in this case means mobility in design as well.

* * *

Every day welding is being used in the production of different articles. For instance, an order was recently received for 2000 window display fixtures. Welding was specified because welding permits any design, gives neat appearance and a strong sturdy assembly at low cost.

* * *

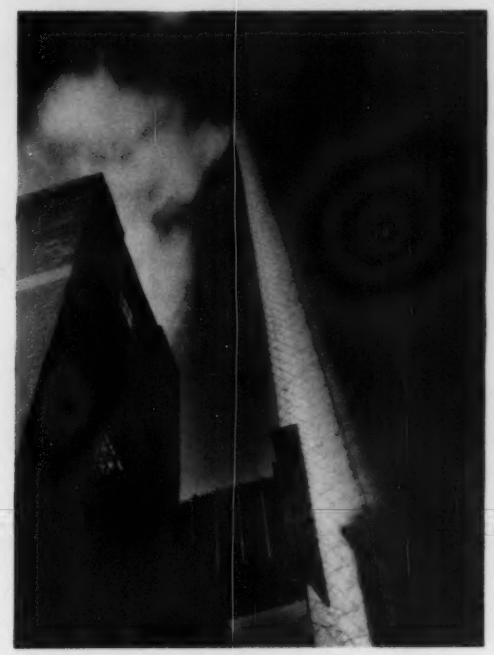
Tomorrow's engineers will be expected to know how to take advantage of this modern metalworking process. Many valuable booklets describing the oxy-acetylene process are available without obligation. For further information write any Linde office.

The Linde Air Products Company
Unit of Union Carbide and Carbon Corporation
UCC
New York and Principal Cities
In Canada:
Dominion Oxygen Company, Limited, Toronto

This is a Business-News Advertisement

THE TECH ENGINEERING NEWS

PUBLISHED BY THE UNDERGRADUATES OF THE
MASSACHUSETTS INSTITUTE OF TECHNOLOGY



VOLUME XIX NUMBER 4

CONTENTS FOR APRIL, 1938

FRONTISPIECE: Beginning of Rocket Flight, August 26, 1937—R. H. Goddard..... 56
SOME ASPECTS OF ROCKET ENGINEERING, by Robert H. Goddard..... 57
ELECTRONIC TELEVISION, by Howard C. Lawrence..... 58
THE GERMAN FOUR YEAR PLAN, by Joham A. Bertsch..... 61
WEATHER FORECASTING IN INDUSTRY, by E. B. Rideout..... 64

Editorials

MILITANT LEADERSHIP FOR DEMOCRACY..... 66
THE RADIO NEWSPAPER..... 67
WHERE WILL THEY LAND?..... 67

Research in Review

COURSE XIX. METALLURGY..... 68
COURSE XVII. BUILDING CONSTRUCTION..... 68
COURSE XIII. MARINE ENGINEERING..... 69
COURSE X. CHEMICAL ENGINEERING..... 74

Engineering Digest

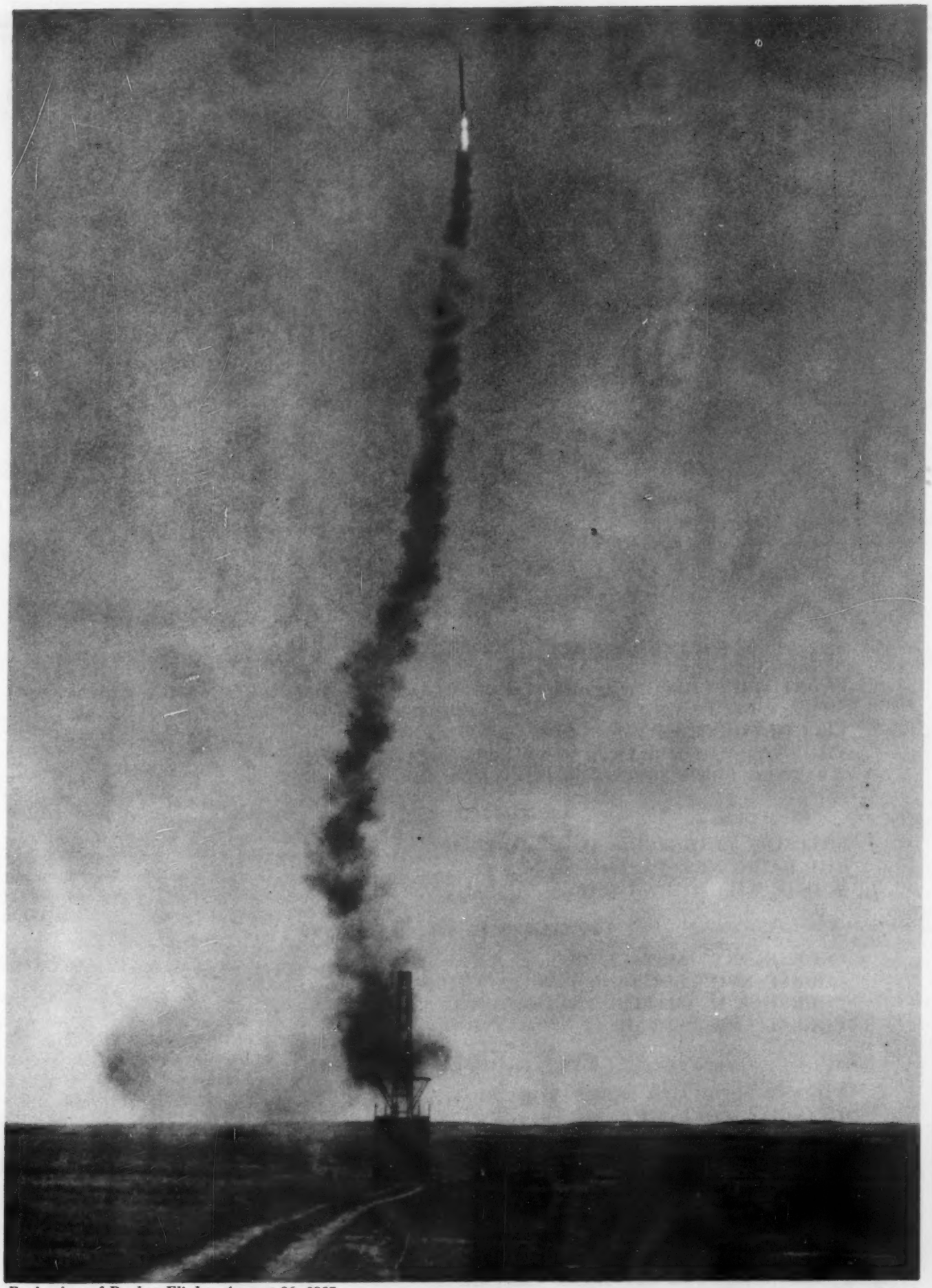
FOREST PRODUCTS LABORATORY..... 70
GRINDING COLD MILL ROLLS..... 70
WHEELER DAM OF THE T.V.A..... 71
MACHINING WORLD'S LARGEST BEARING..... 71

OUR COVER THIS MONTH

The cover for this month is a reproduction of a wood cut made by William L. Schubert,'41, especially for The Tech Engineering News

Published monthly throughout the school year, at Walker Memorial, Cambridge A, Massachusetts, by the undergraduates of the Massachusetts Institute of Technology. Entered as second class matter, at the Post Office, June 1, 1920 at Boston, Mass., under the Act of March 3, 1879. Copyright 1938 by The Tech Engineering News.

Subscription per year $1.50. Foreign $1.75. Single copies 25 cents.



Beginning of Rocket Flight, August 26, 1937

© *R. H. Goddard*

Some Aspects of Rocket Engineering

A SURVEY OF THE ACCOMPLISHMENTS AND OBJECTIVES OF ROCKETRY

ROBERT H. GODDARD

JET propulsion is at last becoming a subject of importance in engineering, largely because of the fact that the limitations of the usual engine and propeller combination are becoming increasingly evident, and also because the rocket offers the only practical method by which extreme speeds may be attained at great altitudes.

The writer happens to be one of the early workers on the serious side of the subject, and called attention to the interesting theoretical possibilities of a highly efficient rocket in a paper published by the Smithsonian Institution in 1919. Although rockets had been in use for hundreds of years, the art had advanced very slowly, permitting several improvements in rocket construction to be patented by the writer in 1914. These improvements were suggested in the 1919 paper; namely, the use of a tapered nozzle for increasing the jet velocity, the feeding of successive portions of liquid or solid into a combustion chamber, since termed a "rocket motor," and the use of a group of rockets of decreasing size, fired in succession, later called a "step rocket."

Calculations, based on what seemed reasonable assumptions, indicated that heights far in excess of the ceilings for aeroplanes and sounding balloons might be reached, if a rocket were constructed having a high velocity of the ejected gases, a large proportionate weight of propellant, and a velocity of ascent that would minimize the effects of air resistance and gravity. The rather startling conclusion was drawn, further, that it should be possible to send a step rocket having a high jet velocity beyond the predominating gravitational attraction of the earth.

Recently a paper has been presented before the Institute of the Aeronautical Sciences by F. J. Malina and A. M. O. Smith, of the California Institute of Technology, in which the same conclusions are reached.

The scepticism with which even the most encouraging theoretical possibilities are received until supported by experiment induced the writer to spend most of his spare time between 1920 and 1930 on the development of a practical rocket, using liquid oxygen and gasoline as fuels. In previous experimental work, from 1914 to 1920, tests had been made with rockets using smokeless powder, both with a single charge and with several successive charges fired in the same combustion chamber. Experiments with powder rockets were discontinued because of the much greater energy contained in liquid fuels, but such rockets, because of simplicity and ease of transportation, still offer an interesting and important field for research. The chief result of the work with liquid fuel rockets was the production of a combustion chamber that could be used without burning out, and which gave actual short flights.

Since 1930, progress has been accelerated by grants from the Daniel and Florence Guggenheim Foundation, and by leave of absence from Clark University during six years of this period. It has therefore been possible to work in New Mexico, under practically ideal climatic conditions. The object has naturally been to reach the greatest height in the shortest time. Once the rockets rose to a considerable height, however, a number of new problems were encountered, each problem opening up a new field for research. Attractive as these special investigations were, it was realized that only sufficient time could be devoted to each as would ensure satisfactory flight.

The rocket motors are very light, developing over two hundred horsepower per pound of motor. Further research is, however, desirable toward increasing the efficiency, which can theoretically be much greater than that represented by the jet velocity of five thousand feet per second of the present flight rockets. A speed of nearly eight thousand feet per second was obtained by the writer a number of years ago, and ten thousand feet per second has more recently been reported by Sänger, although both of these results were obtained in a testing frame, where light weight was of no importance.

One of the problems brought to light by making actual flights was that of stabilization. There has been no difficulty in obtaining strictly vertical flight with purely theoretical high-altitude rockets, as one of the easiest things to draw is a straight line. Actual tests, on the other hand, showed that the fixed air vanes at the rear of the rocket caused it to head into the wind, and hence made high vertical flight impossible. Gyroscopically controlled vanes operating in the rocket blast were accordingly developed, and these produced stabilization as long as propulsion took place, as explained in a report published by the Smithsonian Institution in 1936. Such vanes were, however, useless when the rocket coasted upward after propulsion ceased, and much work has been required to obtain automatic stabilization during this latter period. A further problem has been the satisfactory releasing of the parachute. Progress has also been made in the reduction of weight, and further work is being done along this line.

As to the practical applications of jet propulsion, for purposes other than sending meteorological instruments or other devices to great heights or over great distances, the greatest usefulness appears to lie in the field of high-speed transportation, especially in air of low density. In order to have a direct rocket blast more effective than an engine and propeller, the speed of travel must be several hundred miles per hour, and the craft should be high in the stratosphere, where air resistance would not be excessive. It may be mentioned in passing that the tests made abroad some years ago with rocket automobiles, while spectacular, were of little practical value, because of the comparatively low speeds attained.

In order to utilize the high mechanical energy of the

(*Continued on page 74*)

Electronic Television

● SOUND MOVIES BY RADIO

HOWARD C. LAWRENCE

RECENTLY we have all been hearing a great deal about television. The technical periodicals and the popular magazines and newspapers alike have all been rapidly increasing the space given over to this fascinating subject. In some of the large cities organizations engaged in its development have started demonstrating television to various influential non-technical groups. What is in the wind? Is television really coming to us at last? It is to try to point out where television stands today and what we can expect of it tomorrow that this article has been written.

Television today is a reality in that good, clear action pictures can be, and are, sent and received. The photograph of a television picture reproduced on these pages testifies to the fidelity with which pictures can be sent. The limiting factor in the sharpness of this picture is the method of printing it in this magazine and not in the picture as seen on the television receiver screen. In other words, pictures received on a modern television receiver are as good if not better than the illustrations in most magazines.

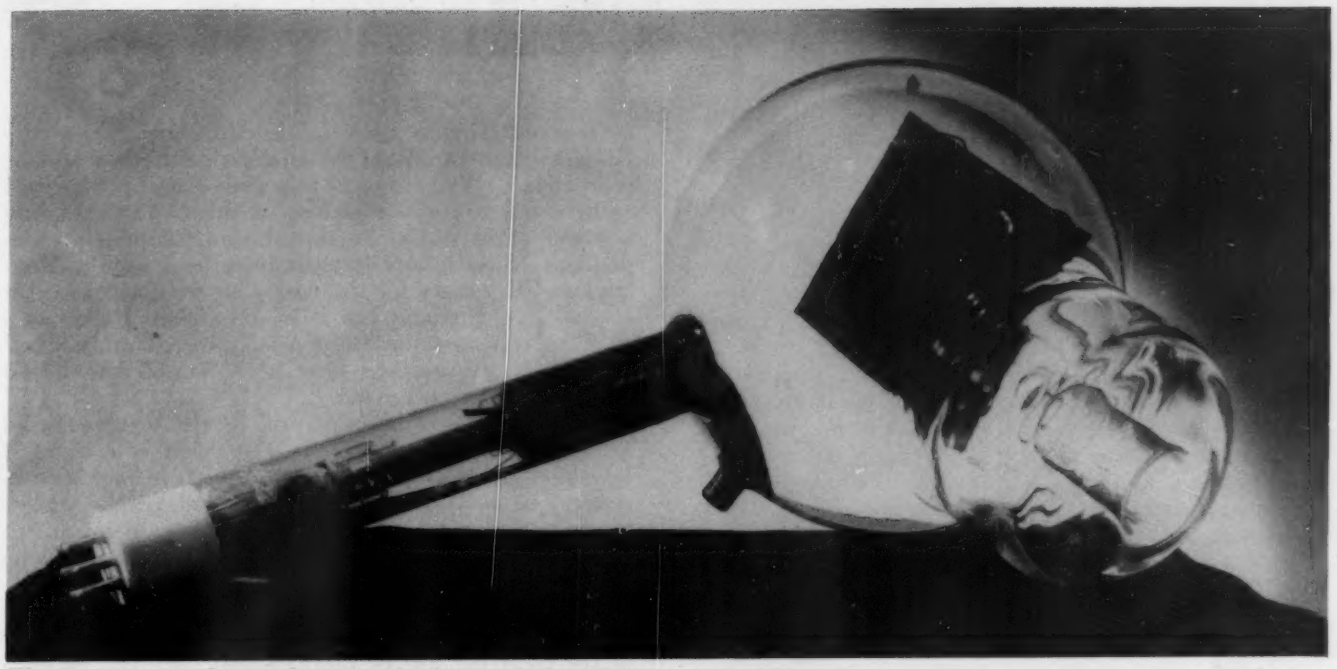
In transmitting a picture it must be systematically explored, and a voltage corresponding to the brightness of the element being explored at each instant must be sent to the transmitter. If this *scanning* process is carried on at a very rapid rate, it will appear to the eye that the complete picture is transmitted at once. The scanning is carried out by starting at the upper left-hand corner of the picture and progressing from left to right and down in much the same way that one reads a book. The number of lines in the picture determines the amount of definition that can be obtained in the vertical direction. The definition in the horizontal direction is limited by the rapidity with which the *vidio* amplifier that amplifies the picture voltages can respond to changes in these voltages. This amplifier high frequency response is usually designed to give equal definition in both the horizontal and vertical directions. Present standards call for a 441-line picture.

In order to convey motion, at least sixteen complete pictures per second must be transmitted. However, to prevent the picture from flickering as the old-time movie did, it is necessary to show at least forty-eight pictures per second. In motion picture projection each picture is projected on the screen twice, so that while only twenty-four *different* pictures are shown each second, forty-eight pictures are projected on the screen. This results in a 50 per cent saving in the cost of film. In television such a system is not applicable. What is done is to scan alternate lines first and then fill in the lines missed the next time the picture is scanned. This is known as *interlaced* scanning. It gives the effect of twice as many pictures as far as flicker is concerned, while it does not require a corresponding increase in the high frequency response of the vidio amplifiers. In order to keep the sixty-cycle power line voltage from spoiling the picture, the scanning frequency must be an integral multiple of the line frequency. Therefore the picture is scanned sixty times a second, resulting in thirty complete pictures per second.

There are several ways in which a picture may be picked up and scanned. The most popular system today uses a camera containing an *iconoscope*. This iconoscope is a vacuum tube containing an electron gun which can shoot a beam of electrons at any elementary spot on the picture plate at the other end of the tube. The picture plate is a sheet of mica about three by four inches in size. The face of the mica towards the gun is covered with a mosaic of minute photoelectric cells, each insulated from the others. The back of the mica is plated with platinum. When a picture is focused on the photoelectric mosaic in the same manner it would be focused on the plate in an ordinary camera, each element of the mosaic gives off photo electrons at a rate proportional to the amount of light falling on it. The electron beam is made to scan this mosaic, putting back on each element enough electrons to make up for those given off because of the light. Since there is a capacity between each elementary cell and the platinum signal plate, it is possible to transmit a voltage corresponding to the number of electrons put back. Thus a picture is started on its way.

After this vidio signal is amplified and put on a radio carrier for transmission, it is picked up on a special radio receiver and again amplified. The pictures at the receiving end appear on the screen of a kinescope, which is just a special purpose cathode ray tube. In this tube there is another electron gun which shoots a beam of electrons at a fluorescent screen, causing it to glow with a brightness dependent on the velocity of the electrons when they hit. By using the signal from the transmitter to regulate the velocity of the electrons,

This 441-line picture shows the clarity of reproduction modern television has been able to achieve — *Courtesy NBC*



The iconoscope, shown above, is the heart of the television transmitter. On it the rays are initially changed to electrical impulses *—Courtesy NBC.*

the different shades of the picture are reproduced. The different elements are placed in the proper place on the screen by deflecting the beam with an electro-magnetic or an electro-static field. In order to synchronize the receiver with the transmitter, a synchronizing pulse is transmitted at the end of each line, and another pulse of a different character is transmitted at the end of each half picture. The complete system is electrical, there being no mechanical moving parts in either the transmitter or receiver.

A typical European receiver is shown in one of the illustrations. The picture received with this receiver is in shades of black and white and is about eight inches high by ten inches wide, the size received with most receivers. Some of the receivers will give pictures about two inches larger, but these are the largest given by any home receiver. Considerable work has been done both in this country and abroad in the development of projection apparatus that will give pictures several feet high, but these systems are still in the experimental stage.

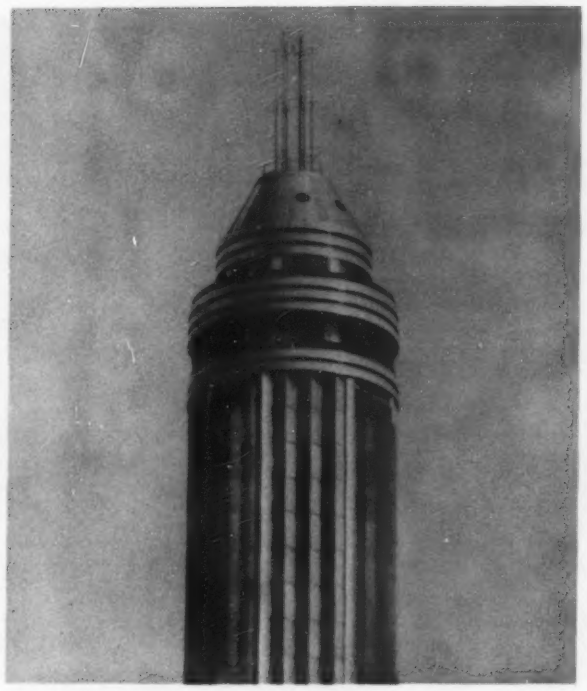
The distance from the transmitter at which satisfactory pictures can be received is limited to between fifty and one hundred miles. This is because radio signals on the ultra-high frequencies on which the pictures are transmitted do not follow the curvature of the earth very well. These ultra-high frequency signals travel farthest when the transmitting antenna is in a very high location. Thus the National Broadcasting Company has its forty-six megacycle transmitter at the top of the Empire State Building in New York, while the Columbia Broadcasting System is putting its station at the top of the Chrysler Building. It is necessary to use these ultra-high frequencies for television transmission in order to get sufficient room in the radio frequency spectrum for several stations. Television transmitters require a separation between stations of at least six thousand kilocycles, as compared to the ten kilocycles separation needed between sound broadcast stations.

At the present time there is only one station in America operating on a definite schedule. That is the Don Lee television station in Los Angeles. This station, however, is not using the standard type picture, and any receiver built to receive its signals could not be used with any other station. In the New York area is the NBC Station, which is soon to go on the air again with test transmissions, while the CBS Station is expected to go on the air sometime this spring. Two other experimental laboratories in this area have made application for experimental transmitting licenses. In the Philadelphia area three experimental transmitters are being operated by RCA, Farnsworth, and Philco. In Boston there is one station operated by the General Television Corporation. Other cities that are expected to have television stations soon are Albany and Schenectady, N. Y.; Bridgeport, Conn.; and Kansas City, Mo.

The combined question of economics and transmission standards have been the factors in keeping television from us so long. Unless all transmitters send out the same type of signals, it will be necessary to have separate receivers for each station, or else a very complicated receiver that would be too difficult for the average owner to operate. Some of the standards have now been established, and it appears that it will not be long before a complete set of standards is decided upon.

The economic question is one that still has to be solved. For the broadcaster the question is, "Who will pay for the transmitter and the programs?" In England this question was answered by the British Broadcasting Corporation. This is a government corporation financed with taxes collected from all those owning radio receivers of any sort. In this country it is expected that the broadcasts will be paid for in much the same way that sound broadcasting is financed; namely, by the advertiser. But before the advertiser will pay for a program he must be assured of a large audience. This means that the station operators must first invest a large sum of money in erecting a station and putting programs on the air so as to build up an audience before they can expect any financial return.

For the listener the question is, "How much will it cost me?" There are no television receivers on the market in this country today. In England a receiver



More than 1,250 feet above Fifth Avenue, on the Empire State Building, is perched NBC's television antenna —*Courtesy NBC*

costs between two hundred and fifty and five hundred dollars, depending on the size of the picture, the quality of the picture, and whether the sound receiver is included. Some of these receivers have been so designed that they may be used as regular sound broadcast receivers when the television station is not on the air.

Another of the great problems is the interconnection of stations for program syndication. The greater the number of stations carrying a given program, the greater the size of the audience, and the more justification there is for the advertiser's putting on an expensive program. Television stations cannot employ the regular telephone lines used for sound program work. They must either use a special *coaxial* cable or else use relay transmitters between stations. Coaxial cable is expensive to install and relay transmitters do not have a very great transmission range. Another possibility would be to record the program on film, copies of the film then being sent to the different stations for transmission.

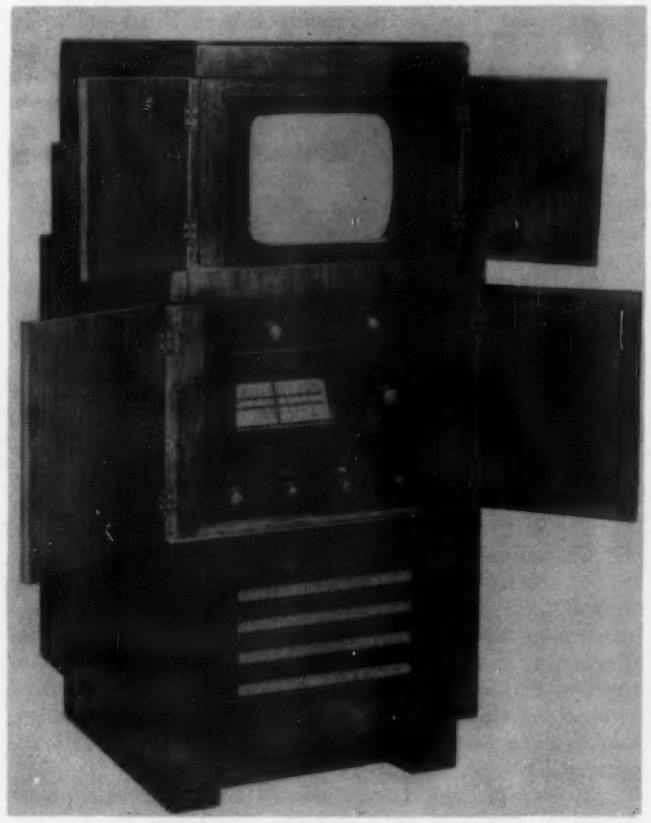
When television does come to us we can expect to see several different types of programs. We can expect to see motion picture films of the type now seen in the theaters. Most probably motion picture producers will not release their feature films for televising, but they will find television a great advertising medium. They can then show their pre-views to a much larger audience, and thus draw larger crowds to the theater to see the complete picture. Television can be made a definite asset to the movie industry.

Another type of program will be the broadcasting of news events while they are happening. The National Broadcasting Company has recently acquired a complete mobile television transmitting station mounted in two large motor vans. One van contains complete studio control equipment for both sound and picture transmission. Two iconoscope cameras are connected with it by several hundred feet of coaxial cable. Microphones equipped with parabolic reflectors pick up the accompanying sound. The second van, connected to the first by coaxial cable, contains the picture transmitter. A special beam antenna on the roof will be used to transmit signals back to the transmitter atop the Empire State Building, from which point they will be rebroadcast. The range of this mobile unit is expected to be about twenty-five miles. A third van containing a power plant will make this station completely independent. Similar mobile units have been used in England and Germany for the past year with considerable success. In England the BBC television trucks were used to transmit the Coronation procession this last fall, while at another time the Wimbledon tennis matches were transmitted.

A third type of program will be the regular studio broadcasts with live talent. Television will make it necessary for the actors to memorize their lines, and in general to behave in front of the television camera much as they would in front of a movie camera, except that in television scenes cannot be discarded and done over if a mistake is made.

Television will not replace the regular sound broadcasts but will supplement them. Most probably many of the receivers will be built so that they can be used for both television and sound and regular sound broadcast reception. Then when you want music while working, the sound receiver alone can be used. When there is time to sit down and watch a show, the picture receiver can be used.

Just how long it will be before we receive these television programs is a matter of much discussion. From present indications some of the large cities will be having television programs on a regular schedule of a few hours a day within the next year or two. Once the standards are decided upon so that receivers can be built with some assurance that they will not be obsolete in the next few months, television will advance more rapidly.



A typical English combination broadcast and television receiver is shown at right —*Courtesy Dumont Laboratories*

The German Four Year Plan

INDUSTRIAL AND ECONOMIC FREEDOM PLANNED FOR THE "NEW" GERMANY

JOHAM A. BERTSCH

YOU have heard before that Russia has had two five year plans. The difference between these and the German Four Year Plan is that the Russian plan is economic planning. That is, the old Russian economic system based on private ownership was wiped out by the revolution, and a new economic system was set up, based on state ownership and state management. The state owns, controls and regulates everything. Against this, in the German system the state owns very little, but regulates and supervises the economics of all vital branches of industry and agronomy. The principle of private ownership and private initiative is maintained as far as possible. This is the fundamental difference between these two systems.

The Four Year Plan in Germany was not just a wild idea of a group of politicians who wanted to broaden their power, but was a bitter necessity brought about by the lack of gold for balancing the budget, the loss of vital raw material sources by the Versailles Treaty, and the turmoil in labor situations.

After the war, Germany owned about two billion marks of gold (about four hundred and seventy-five million gold dollars). This gold reserve shrank rapidly when the Versailles Treaty went into force. Huge sums of gold had to be delivered to the newly created states, such as Poland, etc., for buying food for its half-starved population and subsequent payments of all kinds of reparations and debts. The present gold reserve is about seventy million marks, a ridiculously small sum compared to the huge amount of gold that we have stored at Fort Knox.

In order to understand the situation more clearly, we can compare Germany with our own State of Texas. Germany has a population of approximately sixty-five million to an area of 183,733 square miles, whereas Texas has a population of 5,824,000 to an area of 265,896 square miles. 20,000,000 acres of Germany's area are under cultivation.

Germany was economically well balanced before the great war; about half industrial and half agricultural. The Versailles Treaty, however, destroyed this balance completely. She lost 65 per cent of her iron ore, 45 per cent of her coal, 72 per cent of her zinc, 57 per cent of her lead, 15 per cent of her agricultural surface, 10 per cent of her manufacturing plants and 10 per cent of her population. No industrial country can well stand such a shock.

The post-war industry lived, to a large extent, on credit, either directly or indirectly. American bankers, particularly, supplied such credit and took their slice of profit in advance. The American investor now holds the bag.

This unsound economic system finally collapsed. The bankruptcies in business reached record figures. The number of unemployed people reached over six million (nearly 10 per cent of the population), and finally the power fell, as a ripe fruit, to the party of Hitler. The government did not have enough money on hand to "prime the pump" and other means had to be found to bring the people back to work. Thus originated the Four Year Plan.

The method was successful, as at present there is practically no unemployment in Germany. The work created under the Four Year Plan was one of the means of bringing industry and agriculture back to normal and of lessening unemployment.

The Four Year Plan has been set up on the premise that through national planning there will be produced domestic products formerly imported, or substitutes for imports, thus reducing the import surplus and bringing the whole into balance with the means of payment.

Another important side of the economic planning is to reduce the waste of materials and energy to a minimum and to recirculate reclaimed raw materials as much as possible. One idealistic standpoint which is highly cultivated is to preserve the available sources of raw materials wisely so that future generations may have something left from their fathers. Another point is to develop and expand domestic resources for industry and agriculture. The imports of a country depend upon the geographical and climatical position of the country and the ability of the population to manufacture its necessities. As far as the latter point is concerned Germany is in an excellent position to do so.

It possesses as highly skilled artisans and mechanics as the world has yet produced. Its engineers and technicians, in fact all of its professional men, rank with the highest. Nowhere has education been more universal or carried to a higher degree. The Germans are highly receptive for metaphysics, and the new government has implanted into many of them, particularly the young generation, idealistic ideas for which they are ready to undergo any sacrifice. Thus a spiritual atmosphere has been created which guarantees a good coöperation and operation free from disturbances by labor trouble. The disturbing elements, the professional agitators, had wisely been removed from the scene: many of them make this country and France happy with their presence.

The resources of a country given by mother nature in form of mineral resources, value of soil and climatic conditions are a gift of God, and the only thing which the population can do is to develop that which they have to a maximum of efficiency. Here it is not the politician but the engineer who actually can do something.

One of the most important branches of industry is the automobile industry. Therefore, I would like to stress the development of it under the Four Year Plan.

The fundamental difference between the United States and Europe is that the United States has raw materials in abundance, while Europe does not.

Germany formerly had to import raw materials in value of forty-five and five-tenths million marks for its automobile industry, but the exportation reached seventy-five million marks in 1936 or a gain of thirty million marks.

Germany has to import the following items for each automobile of the 1.7 liter class:

8 kg. copper 3 kg. tin 16.2 kg. lead 0.2 kg. nickel 1.2 kg. chromium 0.4 kg. molybdenum 39.5 kg. crude rubber (caoutchouc) 0.6 kg. asbestos 19.2 kg. cotton 9.0 kg. wool 1.6 kg. jute 4.0 kg. horsehair 3.0 kg. lacquers 3.4 kg. zinc	Value 130 marks, which equals 3½ per cent of the value of the automobile.

The problem of the Four Year Plan is to find suitable substitutes or new raw materials in order to reduce the imports to a minimum. I will later discuss how Germany saves importation of various raw materials.

The automobile industry needs good roads. Good roads make driving a pleasure which stimulates the desire to possess a car. But further, the people save gasoline, material and time. Germany, under the Four Year Plan, has built model highways called "Reichsautobahn", which serve this purpose. The plan provides 7,800 kilometers of such highways. After four years 4,000 kilometers are finished or under construction.

The R.A.B. is a net of superhighways crossing Germany from North to South and from East to West. It is of the highest strategic and commercial value.

The highway itself consists of four driving lanes, two in each direction, separated by a grass lane which is generally planted with shrubbery to reduce the headlight glare of cars coming in the opposite direction.

The construction is of concrete reinforced with steel. In order to save weight a high-grade quality of steel was selected. Under the plan not more than one per cent of the steel production of Germany should be used. The surface covering varies — gray surface, black rough surface, and little stone blocks about four inches square. In the beginning many men are employed; later labor-saving devices are used. In the construction of bridges to span valleys and gulleys, concrete and much stone are used, and only for long spans is steel employed. This greatly increases the employment of men in the stone industry which is located, for the major part, in southern Germany. Stone bridges look good, are more adapted to the landscape, increase tourist traffic by beauty, last for centuries and are resistant to aerial attacks. Curves may not be below one kilometer in radius.

Full speed is made possible owing to the elimination of crossings, either over- or under-passes being used. Highways are only for automobile, truck and motorcycle traffic, eliminating bicycle, pedestrian and horse-vehicle travel. The speed factor is further increased, as the highway goes around all cities and villages. All of these factors contribute to an increase in speed of 68 per cent, with a saving in gasoline at equal speeds of 42 per cent. Shifting on the R.A.B. is 16 times to 440 times and 4 times to 289 times against that of the ordinary highway in given distances, or 26 times uniformity. Elimination of passing of vehicles is 88 per cent. 92 per cent of the trip may be made at full speed. For the stretch Bruchsal-Bad Nauheim the circumference movement of the steering wheel was 0.59 meters on the R.A.B. as against 336 meters on the ordinary highway. Brake power to be applied for 100 km. on the R.A.B. is 2.71 mkg. against 289 mkg. on the ordinary highway.

The natural resources of Germany are very small, producing only 400,000 tons of petroleum products per year, an additional four million tons being necessary. The production of domestic lubricating oils from petroleum has been raised from 34 per cent in 1934 to 69 per cent in 1937. The motor fuels, however, are produced in a rapidly increasing quantity by synthetic chemical processes.

There are three main processes for synthetic production of fuels:

1. The Bergius Process I.G.
2. The Fisher-Tropsch I.G.
3. Pott & Broshe Process Stinnes

The Bergius process was invented in 1913 and is based on the liquefaction of coal. The great chemical concern, I.G., acquired the patent rights, and a great staff of chemists and engineers perfected the process. The research and pilot plant work was done in Oppau. In the year 1926 the workability of the process was demonstrated and in 1935 production had reached 1,000 tons daily in Leuna. Leuna is a huge manufacturing plant of the I.G. located in Central Germany, covering eight square kilometers and employing 11,000 workmen. Huge brown coal deposits are located very close by and are mined by the open pit method. The brown coal is pulverized, mixed to a paste with oil and catalyst-solution in mixers which consume 15 tons of coal per hour. The paste is preheated, compressed to 200 atmospheres and pressed into high-pressure tubes of 30 m. height and 14 cm. wall thickness. A battery of four converters each is enclosed in a concrete chamber, open at the top in case of a breakage, etc. The complete process is remote controlled. Hydrogen, mixed with the paste and catalyst at about 500° C., causes the combination of hydrogen with the coal. Coal consists of solid hydrocarbons, the carbons predominating, whereas liquid hydrocarbons, like gasoline, have more hydrogen in the molecules. What actually is done in the Bergius process is to introduce more hydrogen into the molecule by pressure. The large molecules of coal break up under the influence of heat. The primary reaction product is the middle oil. This is conducted into new converters and cracked, under the action of fresh catalysts, to gasoline, which is fractionated in huge distilling columns. Highboiling fractions are returned into the process cycle. The whole process is continuous and is quite a remarkable piece of engineering.

A modification of the process is used if the coal delivers excess tar. Then the coal is first subjected to a dry distillation, tar and coke being produced. The tar is hydrogenated according to the Bergius process, the coke being used in water gas generators to produce the hydrogen required for such hydrogenation.

The Fischer-Tropsch process has been developed in pilot plant scale since 1926 and works quite differently. The coal is transformed into water gas which is freed from sulfur. From such purified water gas synthetic gasoline is made by conducting it at atmospheric pressure at 160° to 180° over a nickel-kieselgur catalyst activated with alumina. Large quantities of gas are circulated, the reaction products being washed out and volatile products absorbed by activated carbon and regenerated by steam.

The price of the fuel oils depends upon the hydrogen content, as the average benzene product contains 14.5 per cent H_2 and Diesel oil 13 per cent, the latter being cheaper.

The Fischer-Tropsch process has been used on a large scale since 1936 in Boehlen near Leipzig and Gelsenkirchen. The plants have a production of

625,000 tons now and more plants are under construction. In the year 1935,700 new patents were issued on this process alone.

The Stinnes Company in the Ruhr has another process called "Pressure Extraction", developed by Drs. Pott and Broche. Coal is extracted at high temperatures and pressure with low temperature tars and tetralene. 85 per cent of the coal is transformed in this process into heavy oils by heat under pressure. One ton of benzene requires 22 tons crude brown coal, 4.5 tons coal, or 1.25 tons brown-coal tar.

Germany needs 2,000,000 tons of light fuels and 2,000,000 tons of heavy oils. In the year 1935, 925,000 tons of light fuels were produced, and by the spring of 1938 all fuels will be made by domestic production. We have to admire this tremendous efficiency.

In the fall of 1934 Dr. Schacht invited all industrial leaders of the brown coal industry to a conference without disclosing the subject. After forty minutes the purpose of the conference had been explained and after another ten minutes all brown coal industry merged under the name of Brownkohlenbenzine Verein, A.G. with two hundred and fifty million mark capital to produce at least a half million tons of synthetic fuel a year. All patents were merged, licenses being given to anyone who is able to produce against a fair competition. The patent laws were changed with the interest of the nation at stake to prevent patent robbery or monopolies. Now the little man is protected against intrigue, abuse, litigation, and his name must be mentioned in the patent.

A very recent report in *Industrial and Engineering Chemistry* tells us that more advanced processes have been introduced in the coking industry, increasing the yields, particularly of benzene. German chemists have also demonstrated that coal tar oils can be used as fuel for Diesel engines if small amounts of "Kogasin" are added. "Kogasin" is an intermediate product of the Fischer synthetic gasoline process. This is a good illustration of the value of new products in making an established piece of equipment, in this case the Diesel engine, more efficient.

The breaking of the oil monopoly is of the greatest importance to the progress of mankind. Oil was actually the monopoly of two big concerns, the Standard Oil and Dutch Shell Corporation. Oil is a basic product for modern automobile industry, aviation, steamship transportation and warfare.

In the field of aviation the Diesel engine is rapidly replacing the gasoline motor. I saw the first three-motored Diesel-engine planes in Frankfurt in 1936. As to the recent developments, I quote from *Science News*, 1938, page 55:

"The public will some day be no more required to fly in gasoline-fueled airplanes than in hydrogen-filled airships, government aviation scientists predicted at the meeting of the Society of Automotive Engineers in Detroit.

Ernest G. Whitney and Hampton H. Foster of the Langley Field laboratories of the National Advisory Committee for Aeronautics based this forecast of aviation's future on their study of Diesel engines for airplanes as a potential replacement for present gasoline-fueled motors. The almost negligible ability of Diesel fuels to burn except under the special high pressure and temperature conditions within a Diesel engine is the reason for their startling statement.

'The use of super-gasolines of 100 octane anti-knock rating will bring an improvement in gasoline-fueled airplanes,' state the N. A. C. A. experts, 'but the Diesel engines used in German airplanes today are accomplishing what enthusiastic engineers are only predicting for gasoline motors five years hence.'

'Well qualified authorities,' they state, 'predict for the 100 octane gasoline engine in the next five years specific fuel consumptions no better than 0.38 pounds of fuel per brake horsepower hour and specific engine weights in a 2,000 horsepower unit no less then one pound per horsepower, whereas, the Junkers Jumo engines are operating today at specific fuel consumptions as low as 0.36; and a 2,000 horsepower engine development is in progress to weigh less than one pound per horsepower.'

Forgetting about the technical terms used, the scientists are saying that five years from now gasoline fuel engine advocates predict a certain fuel consumption (0.38) with engines weighing 2,000 pounds that can create 2,000 horsepower. And they add that present-day Diesel engines are already operating with a lower fuel consumption (0.36) and that there is now being built a Diesel engine generating 2,000 horsepower which will weigh less than 2,000 pounds."

But in Germany they are going even further and have great hopes of adopting the producer gas principle to the driving of airplanes. Producer gas is a broad term for a mixture of combustible gases with nitrogen of the air. The most common type is made by blowing air and steam through a glowing bed of coal. The carbon burns primarily into carbon dioxide and this gas is reduced to carbon monoxide by passing through an excess of glowing coal. If steam is injected with the air, the steam forms with the carbon a mixture of 50 per cent CO and 50 per cent H_2, called water gas. The regulation of the air and steam must be adjusted so that the heat balance in the fuel is maintained. Producer gas engines are making rapid progress in Europe towards a reliable piece of machinery.

The producer gas driven motor trucks are not such complicated devices as one would suppose. The producer sits alongside the driver and is a small cylindrical apparatus holding a supply of fuel in form of wood or briquets (brown coal) in its upper portion. Through a very simple filter, gas goes to the engine intake through a butterfly valve. The engines are started on gasoline with the ordinary carburetor system, and as soon as turned over the producer is lighted by a taper or a piece of oil-soaked waste. By the time the operator has climbed into the cab he is ready to switch off the gasoline and its carburetor system and switch in the producer gas stream. The whole operation consumes only a minute or two for smaller machines, but slightly more for larger ones. With wood as a fuel, the radius of action is not so great, but with some specially prepared fuels the weight of the producer and a stock of fuel is less than that of a gasoline tank filled for the same mileage. This information is taken from *Industrial Engineering Chemistry News*, 1937, page 150.

Another important development is the Rupa motor, driven by pulverized fuel. It introduces pulverized organic material, such as coal dust, wood, straw, flour and other combustible waste, under 80 atmospheres pressure into a special Diesel engine and obtains 32 per cent efficiency of the combustion value. It is 80 per cent cheaper in operation than the oil Diesel and 95 per cent cheaper than the gasoline engine, one horsepower hour costing ½ pfennig. The inventor, Rudolf Parlikowsky of Goerlitz, has secured his rights by 120 patents. With this type of engine three million tons of coal or 1/40 of the present production would furnish all the necessary power for Germany.

Weather Forecasting In Industry

• SNOW, RAIN AND SUN AFFECT THE NATION'S BUSINESS

E. B. RIDEOUT

THE demand for a forecast of the weather conditions from the weather man is as varied as the weather itself. He may be so busy that he could use the services of a half dozen assistants all at one time, and then again he may not find enough to keep himself busy as far as furnishing forecasts are concerned. To explain it in other words, he can be swamped with telephone calls during a snowstorm, which is typical of a day's activities in the northern climates, or he may be as much at leisure as a southern forecaster with conditions as they normally occur in those regions.

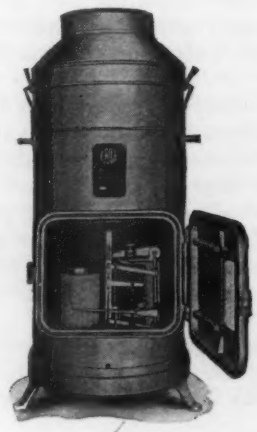
A forecaster in a city of any size has different ways of getting his forecast out to the public. There are the newspapers, the telephone and, in the case of the writer, the radio. In the latter instance, the forecasts are prepared and broadcast from Station WEEI every morning and night. When conditions become unusual, such as the coming of a sudden storm or cold wave, special forecasts are prepared and are broadcast at the earliest possible moment. In this case, when special forecasts are necessary, they are best released with the regular broadcast of news information which is given out during the day.

In order to prepare weather forecasts, the weather man must know what conditions are over the country before he can make up his forecast. This information is furnished by the United States Weather Bureau. Observations are taken at a great number of stations over the North American continent, and this information is then telegraphed and radioed out in code form and is available to anyone knowing the code. Weather maps are then made from the information that has been received, and a picture of conditions in barometric and temperature lines is drawn. This makes it possible for the meteorologist to make up his forecast. If conditions are nothing out of the ordinary, the usual daily routine follows.

But on the other hand, if a decided change is on the way according to the weather map indications, then the value of weather forecasting immediately comes to the front. And without a doubt the first business to be affected, although in an extremely local manner, is the telephone from the weather forecasting centers. Telephone calls must be made to services subscribing for weather information in the event of developing conditions. The size of the users of this service may vary anywhere from small groups holding outings up to the state highway departments and transportation companies, such as those operating several thousands of miles of trackage.

These forecasts are released as soon as possible, so as to give those who are interested as much time as can be reasonably expected to make preparations for what is on the way. If the forecast is for rain, the small business or social group may cancel its outdoor activities and make it an indoor affair instead, or they may postpone it to a later date. But when the street departments and transportation companies get the first forecast for snow, and if the forecast comes through during the morning or any time during the day up to closing time, all of the heads and sub-heads are notified that a snowstorm may break before the following morning. This gives them a chance to be within telephone communication after leaving their places of duty for more information in regard to the expected storm.

Naturally, as everyone who has to constantly keep in touch with weather forecasts knows, there may be either a change for the better, which would mean to them that the storm was shifting its course in another direction away from them, or further developments might prove the storm to be one that would require plenty of machines and man power to be in readiness when the storm arrives. Now even though the nature of the precipitation is a matter of very much importance when a storm is expected, it becomes even a greater necessity in knowing just the order in which the precipitation will take place on the follow-up calls before the storm sets in. For instance, they wish to know whether the storm will start with snow and end with sleet or rain or vice versa, or, if it is to be entirely a snowstorm, the question is then, how much, or how many inches of snow may be looked for by those responsible for removal of snow. In the case of the state department a more complex forecast is involved; for areas of any size, such as any particular state, the depth of snow almost invariably differs anywhere from a trace to a foot or more. And then again, a storm in one part of a state may cause a freezing rain, which would necessitate sanding; and in another part, deep drifting snow would mean that plows would have to be used. Storms that are expected to cause less than a certain number of inches mean that scrapers and sanders will take care of the removal of snow, while the heavier snowfalls mean



naturally that plows will have to be put into service.

Forecasts for any particular storm are not merely confined to the time it breaks, for information is desired from the forecaster even more frequently during the storm than before, because officials are anxious to get the first inkling the forecaster may have as to any change the storm may undertake while it is in progress.

Not only do those responsible for snow removal and sanding have to work every minute of the time when a snowstorm is in progress, but there are many others that are also affected vitally during a storm. Transportation companies have to receive word as soon as possible. Street railways are interested in the same information that the street and highway departments are. For they want to know whether it will be necessary to use sanders and scrapers or whether it will require plows. Motor transportation companies find great value in a knowledge of the kind of weather that is to be expected. If a heavy snowstorm which will reduce, if not practically check, the speed of transportation is expected, then the shipping or receiving departments act accordingly. A knowledge of what may be expected in temperature changes, or what the temperatures may be in localities where goods are to be shipped, is of much importance to transportation companies.

When it comes to temperature forecasts, it is of vital interest to the business houses which ship perishable goods. One big chain-store company, particularly during the winter months, received twice daily from the writer a temperature forecast north, west, and south of Boston. This enabled them to make their shipments accordingly. If the temperature was expected to fall a certain number of degrees below the freezing point, in one or more of the directions that they were interested in, then they would take suitable precautions against freezing. During the winter months, it often occurred when the goods were being prepared for shipment that the weather was not only mild at the place where the shipments were, but the weather was also mild over the regions that they were interested in, but nevertheless, not far to the west and northwestward, a sudden cold wave was advancing rapidly which would within a few hours cause a very sudden fall in the temperature. Such forecasts as these, coming in due time, mean a great saving to those who are making shipments of thousands of dollars worth of perishable goods every day. It is not an uncommon thing to have cold waves sweep down following mild spells in winter and cause the temperature to fall anywhere from thirty to fifty degrees or more in eighteen to twenty-four hours.

In the summer months another branch of industry is interested in knowing what to expect in sections of the country where goods are to be shipped. For instance, candy manufacturers must know what the weather is going to be, not only locally, but in the regions where they are to make shipments. Frequently here along the New England coast during the summer months light easterly winds will keep the temperature at a comfortable to cool reading, while just to the westward, over eastern New York State, midsummer heat will prevail which will extend from there westward to the Rocky Mountains. If this is known beforehand, then shipments to the regions of heat will be prepared accordingly.

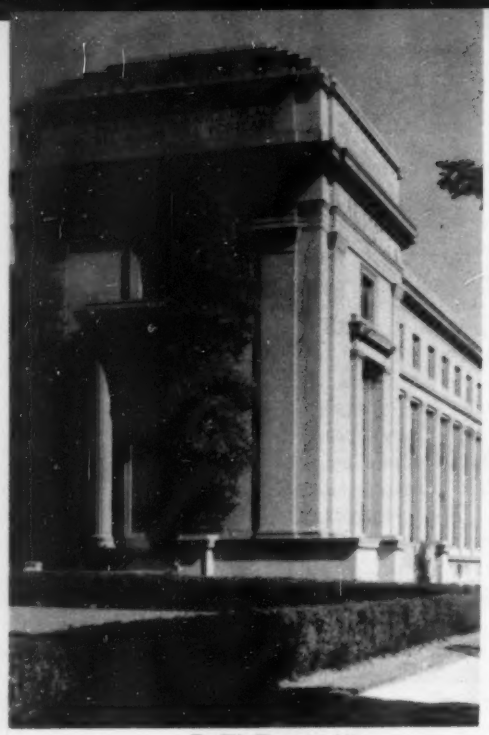
Another business affected by changes in temperature is the restaurant business. People do not begin to realize what a change in temperature during the forenoon will mean to the appetite. The temperature may hold to a high average for several days during a summer heat wave. The restaurant keepers will keep stocked up on summer dishes, when suddenly a cool rainy spell will set in and catch them unaware. One common phase in the summer weather is when every indication points toward a warm day with light winds from the southwesterly or westerly. The thought in everyone's mind, when thinking of food, is to drink cool beverages and eat light dishes such as salads or sandwiches. But suddenly, just before lunch time, a cool breeze will blow right in from the ocean, or down from the northern regions, and cause a fall in the temperature of several degrees, and with this sudden temperature fall, the appetites of everyone will also change. The result will be that instead of cool drinks and salads, hot soups and warm, substantial foods will come quickly in demand. One restaurant official stated that a sudden change caused their loss in certain foods to run into tonnage.

There are many other industries that are dependent upon temperatures. During the winter months, very frequently in connection with heating services, repair work must be carried on when the weather becomes mild enough to permit the turning off of steam for a few hours, so that the repairs can be made without the danger of damage from too sudden a temperature fall. Wind velocities also enter into conditions such as this, for though the temperature may be only slightly under the freezing point where repair work is contemplated, if the wind is going to be too strong, repairs may be put off for more favorable conditions.

Concrete construction is another business that is dependent upon temperatures during the winter months. The pouring of concrete will not be attempted in the majority of cases if the temperature is expected to fall below the freezing point within ten to twelve hours. Or if it has already been done, and they have learned that freezing temperatures are soon to arrive, precautions, such as covering over the concrete where possible, will be taken to prevent any damage being done.

The farmer is another person who is not only dependent upon temperature changes, but is either the beneficiary or the victim of every kind of weather. The weather either makes or breaks the farmer, and everyone is fully conscious of the tremendous effect the weather has on him. As far as temperatures are concerned, from the time the growing season begins in the spring until it is over in the fall, he must watch the thermometer. This is particularly true during the late spring and late summer, or early fall, when the frost season is at hand. Moreover, practically everyone knows that the farmer is guided wholly in his long hours of daily labors by what the weather is. If he is planning to get in a harvest of hay, he wants to make sure that the weather will be good for a few days, so that he can

(*Continued on page 72*)



THE TECH ENGINEERING NEWS

Managing Board

JOSEPH J. DONOVAN, '39
Editor-in-Chief

WILL B. JAMISON, '39
General Manager

PAUL B. M. FARWELL, '39
Business Manager

NORMAN L. LASCHEVER, '40
Associate Editor

EUGENE E. CRAWFORD, '41
Art Editor

SAMUEL P. CARD, '40
Advertising Manager

JACK H. SCHAUM, '40
Associate Editor

JAMES L. BAIRD, '40
Publicity Manager

EUGENE S. WEST, '40
Circulation Manager

JOHN G. LESCHEN, '40
Managing Editor

JAMES S. RUMSEY, '40
Personnel Manager

GORDON A. FAIRBAIRN, '40
Treasurer

Associate Board

H. N. COTTLE, '40
Associate Circulation Manager

LESTER LEES, '40
Contributing Editor

R. DIXON SPEAS, '39
Contributing Editor

Staff

R. W. BLAKE, '41
J. W. FOLLIN, '41
E. H. HUSTVEDT, '41
W. MORTON, '41
J. W. MULLEN, '41

D. D. SCARFF, '41
B. LOESCH, '41
J. VAN RIPER, '41
K. ATWATER, '41
R. A. MARKEY, '41

G. VINEYARD, '41
D. WATSON, '41
T. C. CAMPBELL, '41
C. N. HASERT, '41
L. WILSON, '41

H. J. HEIMER, '41
J. B. MURDOCK, '41
C. L. HALL, '41
W. UNGER, '41
W. J. MEYERS, '41

THE ENGINEERING COLLEGE MAGAZINES ASSOCIATED *Chairman*, PROFESSOR RICHARD W. BECKMAN, Iowa State College, Ames, Iowa

ARKANSAS ENGINEER
COLORADO ENGINEER
CORNELL ENGINEER
ILLINOIS TECHNOGRAPH
IOWA ENGINEER
IOWA TRANSIT
KANSAS ENGINEER
KANSAS STATE ENGINEER
MARQUETTE ENGINEER
MICHIGAN TECHNIC
MINNESOTA TECHNO-LOG
NEBRASKA BLUE PRINT
NEW YORK UNIVERSITY QUADRANGLE
NORTH DAKOTA STATE ENGINEER
OHIO STATE ENGINEER
OREGON STATE TECHNICAL RECORD
PENNSYLVANIA TRIANGLE
PURDUE ENGINEER
ROSE TECHNIC
THE TECH ENGINEERING NEWS
VILLANOVA ENGINEER
WASHINGTON STATE ENGINEER
WAYNE ENGINEER
WISCONSIN ENGINEER

EDITORIALS

MILITANT LEADERSHIP FOR DEMOCRACY

All over the world freedom and democracy are falling down before absolutism — a Hitlerized Germany annexes Austria; a Fascist rebellion has the democratic Spanish government in the last stages of resistance; dozens of minor nations, sensing where the power lies, have set up absolutist governments; the major advances toward real democracy which have been made during the past century seem imminently in danger of being lost. Why does such a situation exist? Surely the people of the world cannot wish to give up all the privileges which they have gained only after terrible struggles.

Poor leadership is to blame. The presidents, premiers, and foreign ministers of the world's democracies have never in history been such a soft-spined lot as those of today. The Austrian crisis is a typical example of their bungling. Prime Minister Chamberlain of England announced to his constituents and to the world his avowed policy of attempting to pacify Hitler and Mussolini by making concessions rather than by trying to put up a spirited opposition. Such a perfect opening could not be overlooked by an opportunist like Hitler. Into Austria marched the German army while Neville chewed his nails and gasped. France, incapacitated by one of its frequent cabinet failures, could do nothing. Russia, "the most democratic nation in the world," was too busy executing many of its most prominent citizens to pay any attention. Democracy had blundered and autocracy had scored.

Just so long as there were no competent leaders of the opposition, the clumsiness which has been so apparent in democratic leadership for the past few years was unnoticeable. But when Hitler attained power in Germany and Mussolini renewed his vigorous nationalism in Italy, the senility of the leaders of France, Britain, and the United States began to show. First, the Treaty of Versailles went by the board. Then Mussolini took over Ethiopia and Hitler remilitarized the Rhineland. Emboldened by the ease with which the statesmen of the democracies were scared, the two dictators began in earnest to conquer the continent of Europe. Unhampered by the feeble opposition put up by the democratic nations, absolutist propaganda blared forth everywhere. With only a pretense of neutrality, Germany and Italy whole-heartedly backed the Franco rebellion in Spain with men, money, and munitions. Meanwhile France refused to give any active support to the existing democratic government of her neighbor, and Britain rested smugly assured when Mussolini consented to join the Non-Intervention Commission. The Treaty of Versailles, the Kellogg Pact, and a half-dozen other agreements had already been broken by the absolutist powers, but the British statesmen had not the slightest doubt that the new agreement would be honored. Even the obvious failure of the Non-Intervention Commission and the obvious hypocrisy of Mussolini did not dispel the fond dream of the democracies that the only way to fight the dictators successfully was to give in on every point.

It is time that such short-sighted ideas be cast off. The United States, horribly impotent as a champion of

democracy in modern international politics, did not gain its independence by yielding to George III's wishes. The leaders of the French Revolution did not set up a republic by following the orders of Louis XVI. Spanish America did not free itself from Spain by bowing down before its Spanish rulers. Laborers on strike do not win success by serving free meals to strike-breakers. Likewise, in the present international scene, the democracies of the world cannot hope for victory if they fight opposition only by backing down. Democracy had to be militant to achieve its present position. Democracy can be militant again. Democracy *must* be militant again if it is to survive.

THE RADIO NEWSPAPER

Radio has enjoyed much publicity since the beginning of the twentieth century, new developments usually being given immediate attention by the press. A recent development of great potentiality, however, has failed to receive much public attention. This new invention is the radio newspaper.

The idea of a radio newspaper is by no means new — Marconi and his colleagues spoke of it over thirty years ago — but the actual realization of a unit to print a newspaper under the "dictation" of radio waves broadcast on a regular frequency is recent. There are now several machines that have been developed which are capable of printing a newspaper by means of radio. In the receiving set a stylus prints on carbon-backed paper a facsimile of a paper in the broadcasting studio. What is important is that these machines are no longer laboratory question marks, but are being built for mass production. The Federal Communications Commission has already issued eight licenses for experimental purposes. Existing broadcasting equipment is sufficient to transmit the necessary waves.

The possibilities of a radio newspaper are tremendous. The newspaper-receiving units are already being produced cheaply, and once these units are purchased there will be very little expense in obtaining unlimited quantities of news. This economic factor might very well mean the end of the newspapers as we know them today, for the radio newspapers could report news almost immediately after an event had happened, whereas the old type newspaper would have to await its regular edition to report the same event. The convenience to the public of a radio newspaper is fairly obvious; for besides having the newspaper printed right at home, there would be a large selection of news and editorial policies to be had, by merely turning a knob.

The question arises of what will happen to the newspaper industry when the radio newspaper finds its way into many homes, as it will undoubtedly do within the next few months. It might be suggested that licenses for newspaper broadcasts be given only to publishers; but the eight temporary licenses already issued are possessed by regular broadcasting stations. Perhaps the lack of publicity accorded to the radio newspaper has been caused by the publishers' fears of the possible fatal competition that may result. There is adequate cause to believe that the radio newspaper will be the cause of the development of a new technique by the present publications.

There is also the serious question of the continued freedom of the press. Broadcasting stations are now under the control of the Federal Communications Commission, and when radio newspaper broadcasts begin, they too will be under the control of the Government. Thus, if any future administration should object to the news being "radiated" by a particular broadcasting company, the Government might very well suspend the license of the offending station.

What the actual results of the radio newspaper will be, are, of course, still matters for speculation. Yet the potentialities of printing news by radio are sufficiently disturbing to call for some kind of stated policy by the Government with respect to the licensing of radio newspaper stations. A public statement of policy by the Federal Communications Commission would, at this time, be enlightening.

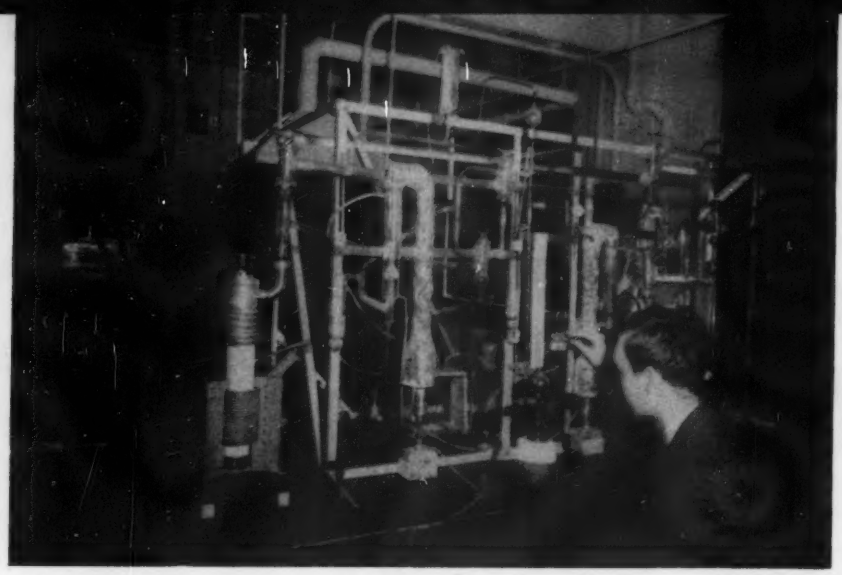
WHERE WILL THEY LAND?

Recently the major airlines announced their joint order of a new super transport, whose general design resembles that of ships in use at present on the more important routes. The new giant will have much greater power supplied by four motors mounted in the wings and will have double the passenger capacity of most ships. If the ship is successful, and there is no reason why it should not be, many more will be ordered. There is, however, one outstanding drawback, our airports.

Practically all of our airports today have sadly inadequate facilities for these new planes. One must remember that as flying speed and weight are increased, the take-off speed must be increased, and as take-off speed is increased, the runways must be lengthened in a proportionally larger rate. Chicago, the metropolis of the Middle West, and logical stopping place for a northern transcontinental route, is threatened with being bypassed because its runways are not long enough. Through the intricate mechanism of law, expansion is being held up by a belligerent railroad which borders on the property. Conditions in our big cities throughout the country are the same. The actual details may be different, but the underlying principles are the same.

Granted that there is a need for expansion and the building of better airport facilities, we are faced with the question of whose duty it is to pay for them. Surely not the airlines; their progressive spirit has already run them in the red. Municipalities have about reached their limit in the amount they will spend for airport facilities. Interstate flying is most assuredly a national problem. The Federal Government recognizes this fact in the form of the Bureau of Air Commerce, which has control of all transport flying in this country. There is no reason why the Bureau should not complete its control by supervision of the financing of land facilities for airplanes. On this suggestion the question is asked, "Where is a sadly indebted Government going to find money to do all this?" In some way, last year, it found several millions to spend on practically useless aviation aids, such as a seventy-seven thousand dollar airport for an off-the-beaten-track Pennsylvania town of two hundred and fifty! Actions like these are purely political; if they were carefully guarded against by the Bureau of Air Commerce, and all expenditures were investigated beforehand, great efficiency with better and more useful landing fields would result. Rentals would partially, if not completely, repay the Government, and we should have established a valuable wartime resource.

European governments have recognized the need for improved facilities and have built them. We have surpassed the Europeans in the efficiency of aircraft, but they have surpassed us in the construction of modern and adequate landing fields. Our Government might do well to follow their example and keep America ahead, not only in the air but also on the land, because the plane has not been built yet that does not need to land.



RESEARCH IN REVIEW

COURSE XIX Metallurgy

In the making of steel, the principal action taking place is the elimination, through oxidation, of carbon, phosphorus, silicon, manganese, and other elements contained in the metal charge. In the open hearth furnace, the oxidation takes place chiefly through reaction between the metal and the slag covering; iron oxide is the most important agent producing the oxidation. It is present in the slag and, to a much smaller extent, in the metal, the ratio of its active concentrations in each being influenced only by temperature, providing equilibrium is reached. A complete knowledge of the equilibria of this and other distributions and reactions is of great value in the control of the open hearth product.

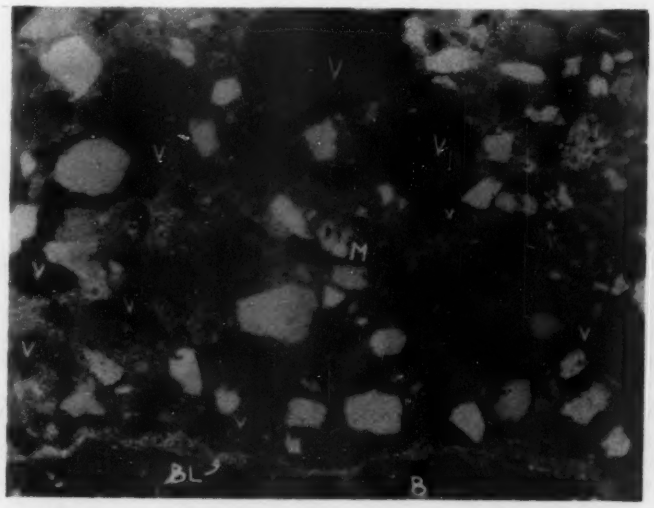
In the determination of these data, and in the work upon equilibrium and solubility of gases in metals and alloys, a system of analysis is a very important tool. The vacuum-fusion method to be described has the advantage of determining hydrogen and nitrogen as well as oxygen. The analyzer, which is shown in the illustration above, is not a new device, but it does have certain refinements not previously used in the system. The principles of operation are simple. The whole system is under high vacuum at the start. The graphite crucible and radiation shields within the silica-tube induction furnace are heated to remove the gases contained within them. This removal is never complete, so a correction factor is determined and applied. The sample is magnetically drawn from the closed glass tube atop the furnace, and falls into the crucible. Hydride and nitride compounds break up at high temperatures, evolving the gases under vacuum; oxygen is removed as CO, by reaction with the crucible. The gases are drawn by a mercury condensation pump to a storage reservoir. When ready for analysis, they are pumped into measuring reservoirs and the pressure they exert is read against a high vacuum, by a manometer containing n-dibutyl phthalate. Water vapor is not considered as evolved from the metal, and is removed before the gases enter the reservoirs, by absorption in a tube containing P_2O_5. After measuring the total pressure of the gases, the CO and hydrogen are oxidized by the copper oxide in a resistance-heated U-tube. The water vapor formed is removed by the P_2O_5 tube, and the gases again pumped into the reservoir or reservoirs. The drop in pressure is considered as due to removal of hydrogen. Circulation of the gases through ascarite removes CO_2, and the loss in pressure from the time before is recorded as double the pressure of the oxygen removed from the metal. The balance is nitrogen. The volumes of the reservoirs having been determined by calibration, the percentages of the gases in the sample may be calculated from the pressure. When the volume of gas is small, just the small reservoir is used, in order to obtain a more easily readable pressure.

By removing the gases from the metal at a number of different temperatures, some conclusions may be drawn as to the nature of combination of the oxygen and the amount of inclusions of such substances as SiO_2 and Al_2O_3 present in the steel. Tin is used to lower the melting point and prevent reoxidation of any condensed manganese vapors.

The vacuum-fusion analyzer constructed here will be used as an analytical tool in the study of open hearth equilibria, and in the investigation of solubility and other phenomena in connection with gases in metals. It is applicable to other metals besides iron and steel.

COURSE XVII Building Construction

The analysis of the behavior of cementitious materials in concretes and mortars has thrown some light on many unexplained and often detrimental characteristics of these materials. To control their behavior has been the object of a great deal of research by many investigators. Our Building Materials Research Laboratory is just completing what will perhaps prove to be the most complete record of the volume changes of mortars.


V
V
V

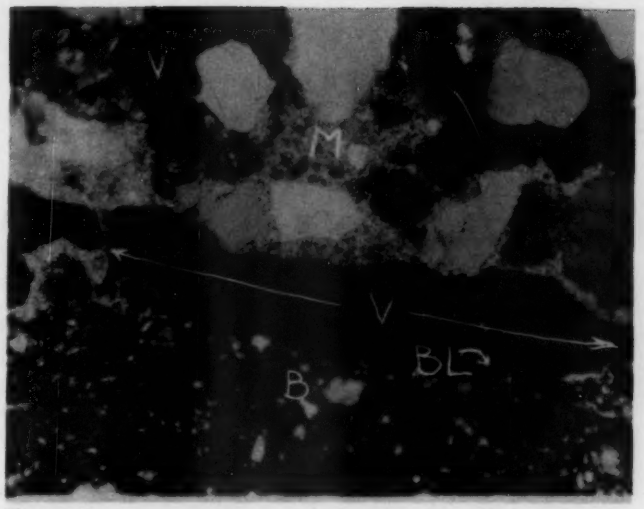


Figure 2

Plotted results of several of these mortars have made possible informative charts. These specimens have been under observation since December 1935 and involved a twenty-eight-day period of curing, two hundred and seventy days for stabilization, and five cycles of wetting and drying covering a period of one hundred and eighty-three days, when these curves were made. Ten additional cycles have since been added to the data. The readings are taken with the Whittemore Strain gauge, which reads accurately to one ten-thousandth of an inch. These curves show, among other things, that high-lime mortars stabilize more rapidly than high-cement mortars; that high-lime mortars have a greater initial shrinkage than high-cement mortars; that high-lime mortars approach a much smaller volume change due to wetting than do the high-cement mortars; and that high-lime mortars show rapid expansion upon wetting and thus cause early repulsion of moisture.

A study of old brick walls has enabled the laboratory to observe some extremely interesting natural phenomena. This study was conducted by Mr. H. R. Staley of our staff, and the photomicrographs were prepared by him for this study.

A few of these will be of interest. Figure 1 illustrates a section of a specimen under 60X and polarized light which ordinarily would be considered a good bond if viewed under small magnification and reflected light. What seemed a good contact is far from continuous and intimate. It is through such openings that water enters and causes the carbonation of the matrix which is indicated by the highly birefringent material of the mortar. This was a specimen from a wall twenty-one years old which was built of homogeneous clay brick and a rich cement mortar.

A typical void in a high-cement mortar at or near the brick line, in an eleven year old specimen, has a characteristic highly birefringent shore line. This is indicative of excessive and continuous water penetration. It is known that the wall leaked badly. Either not enough lime was available to build in the void, or else the passage of water was continuous through the wall. Figure 2 shows the contact between the brick and mortar in a one hundred and nine year old specimen of lime mortar. The mortar in this instance has built in at the brick face and the "scar" tissue of highly birefringent material can readily be located. This wall never did leak. Various attempts were made to identify this reconstituted material and finally the centrifuge and X-ray showed that the material was calcite.

COURSE XIII Marine Engineering

Valve Tests

Recently several shipyards have shown an interest in the subject of head losses developed in the valves and fittings which are used in fuel and lubricating oil systems on shipboard. The ship piping arrangement is necessarily compact and contains many valves for its length. In many cases it has been found that the pressure drop through the valves of the system appreciably exceeded the loss in the pipe line alone. The design data now commonly used have been found to be incomplete and in certain instances to lack the accuracy necessary for economical design. It was therefore suggested to the Department of Naval Architecture and Marine Engineering that this field might prove an interesting subject for investigation in connection with undergraduate thesis work.

With this in mind, work was begun by Milton Karr and H. D. Crapon, Jr., 1937, which resulted in data being obtained for one-half inch and one and one-half inch globe valves. The following year L. W. Schutz and A. M. Main, Jr., made similar tests on angle valves.

The valves used in the tests were of the standard Navy two hundred pound brass-screwed type, one-half inch and one and one-half inch nominal diameters. For each test the valve was mounted between two straight lengths of seamless steel drawn tubing, each one hundred and fifty diameters long. The cyclical system used enabled the fluid to be heated, pumped through the test pieces and fittings, and weighed.

The test pieces were drilled on the horizontal diameter and taps were provided for mercury manometers which would read in duplicate the pressure drop over the following regions:

1. Fitting alone.
2. Fitting plus an upstream and downstream length of pipe.
3. An upstream and downstream length of pipe.

In order to obtain the head loss over a large range of flow conditions, two fluids were used; namely, water and oil. The combination of fluid character, pump size, and heating of the fluid gave a range of Reynolds Number of 50–150,000.

The results of the tests were complete curves of head loss for one-half inch and one and one-half inch globe and angle valves over the range mentioned. These results show that certain broad generalizations, commonly accepted in the past, are not true, among these being the theories that the head loss could be taken as constant over a large range of Reynolds Number, and that criticals will occur at the same Reynolds Number for all valves. Furthermore, the practice of substituting the elbow tests made under Professor McAdams of Massachusetts Institute of Technology as a basis, and using Mr. Dean Foster's (A.S.M.E. Trans. 1920) constants for a determination of the head loss in a valve, does not give an accurate result, since these constants are based on the particular valve and assume a constant loss for all flow conditions.

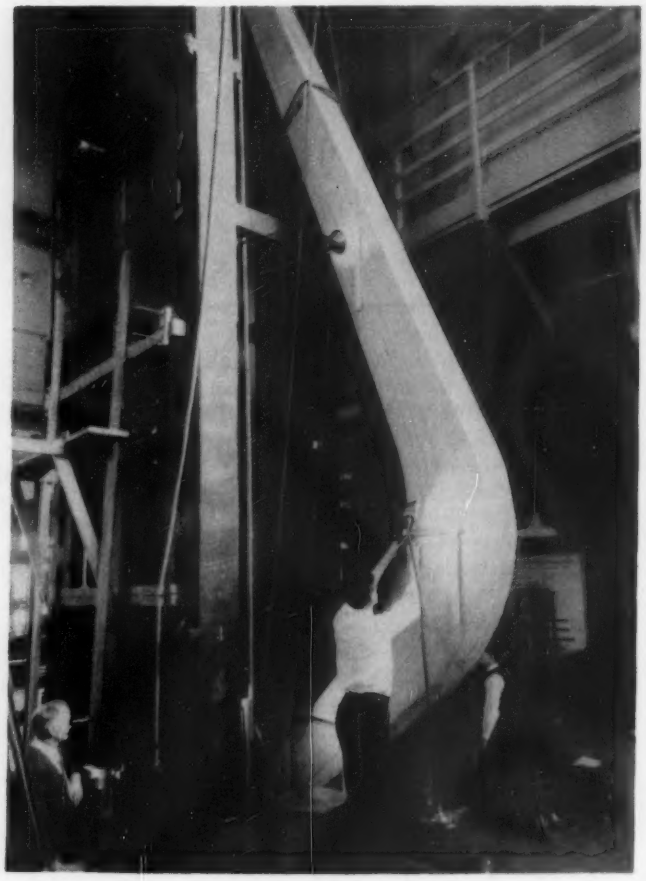
Note: These tests were made possible through the coöperation of the Chemical Engineering Department. The authors are indebted to Professor McAdams and the other members of the staff who made invaluable suggestions.

COURSE X Chemical Engineering

The lower hydrocarbons produced in the cracking of petroleum offer a cheap and abundant raw material for the production of basic organic chemicals. The

(*Continued on page 74*)

ENGINEERING DIGEST



FOREST PRODUCTS LABORATORY

The Forest Products Laboratory, established under the Department of Agriculture in coöperation with the University of Wisconsin at Madison, Wisconsin, is not entirely unknown to readers of TECH ENGINEERING NEWS, there being an article concerning it in a recent issue.

The laboratory confines its activities to the field of the wood itself and to the materials produced from it. Its program is directed toward (1) reducing the cost of wood products, (2) reducing the waste in crop utilization, (3) increasing consumer satisfaction in the service of wood, (4) developing new uses for wood, and (5) aiding foresters by furnishing information on the relation of growth conditions to wood properties and quality.

A thorough study has been made of the mechanical properties of various types of wood as a basis for advanced research. Besides these characteristics, the laboratory has investigated the microstructure of wood, paying particular attention to cellulose and lignin, the two fundamental components of wood.

Chemical treatment of wood for moisture control, protection against decay, fireproofing, etc., have opened a vast field for scientific research. Decay is the greatest destroyer of wood in service. Its prevention is not only of the greatest benefit to wood users but, what is more important, is a vast saving to our potential forest resources.—*Baldwin-Southwark.*

GRINDING COLD MILL ROLLS

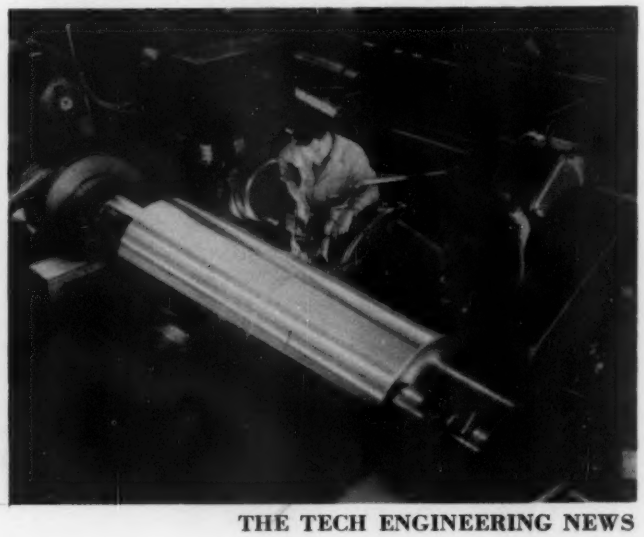
Most cold rolling of strip stock is done by hardened steel rolls whose hard surface and excellent wear-resisting ability suit them for such work. Since these rolls administer the final finish to the stock and give it its finished thickness, it is imperative that they be ground with great accuracy. Most important defects from which the surface of the rolls must be free are chatters, scratches, feed lines, and diamond-dressing marks. The chief causes of scratches are foreign matter from the coolant and load on the face of the grinding wheel.

Choice of grinding wheels depends on the finish desired and upon the condition of the wheel spindle. High finish should never be attempted with a spindle in poor condition. On machines in which there is vibration of the spindle, hard grade and organic banded wheels must be used. However, since vitrified bonded wheels usually have less tendency to scratch, it is better to remove the seat of the trouble by taking up the spindle bearings to stop vibration.

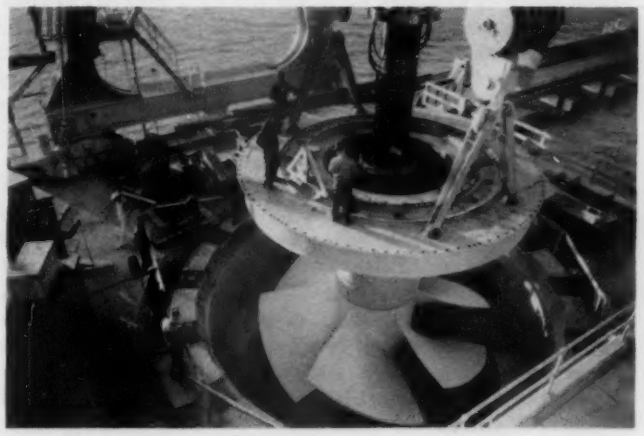
In order to prevent chatters on the roll surface, heavy cuts should not be tried. Generally, the most efficient wheel speed for roughing cuts is about 6,500 s.f.p.m., slower speeds being required for semi-finishing and finishing cuts. Table speed depends upon the condition of the roll surface and the finish desired. Should chatter marks appear on the roll during roughing, the wheel must be dressed before the finish-grinding operation. The roll finish depends chiefly upon the skill of the grinding wheel operator.

The actual grinding of the rolls consists of three steps: roughing, semi-finishing, and finishing. In some cases the second step may be omitted, but not generally. To produce a black, highly reflective surface Alundum wheels are used, while crystolon wheels are used when a gray color is desired.

In order to obtain a good finish it is necessary that the abrasive particles of the grinding wheel penetrate well into the surface of the roll. Therefore, a comparatively small arc of contact must be maintained. The grinding machines mount a standard thirty or thirty-six inch wheel, which is satisfactory for rolls having a diameter of less than twenty inches. The grinding of larger rolls, however, makes necessary the use of smaller diameter grinding wheels so that the proper arc of contact be preserved.



Sometimes, although the grinding machine is in good condition, the grinding wheels according to specifications and the grinding procedure correct, it may be almost impossible to secure a good finish on a roll. In such a case, the trouble may usually be attributed to defects in the roll such as: soft spots on another hard roll, improper balance, or non-uniform center holes. Such faults must be corrected, if possible, if a high-grade surface is desired.—*Grits and Grinds.*



WHEELER DAM OF THE T.V.A.

One of the three power plants at present operating under the Tennessee Valley Authority is the recently completed Wheeler Dam, harnessing the waters of the Tennessee River. Only two of the projected eight turbine units are in operation at the present time.

The turbine units used in this plant are particularly interesting as the runners of the two units have only a small number of blades, similar to a ship's propeller, and unlike the conventional type. Each turbine develops 45,000 horsepower, being the largest of this type ever constructed. The runners are twenty-one feet in diameter and have six steel blades each. The completed runner assembly weighs 235,000 pounds. In operation it requires 4,106,000 gallons of water per minute under full load, a thrust of 1,000,000 pounds being produced upon the blades and then transmitted, with the weight of the runner, to the generator thrust bearing.

In construction, the turbine is cast in parts and assembled at the power plant. Such parts as the stay ring and the lower distributor are imbedded in concrete which then forms the generator floor. Next, the remaining parts are installed, some of which have been partially assembled at the construction plant.

It is interesting to note that the main guide bearing of each unit is constructed of Goodrich Cutless Rubber instead of being the conventional lignum vitae type. It has been found that the rubber withstands the abrasives in the water better than the other type. In construction, the rubber is vulcanized to interlocking steel strips, the end strips being secured to the housing by countersunk screws and dowels.

Wheeler Dam is one of a chain of six dams originating under the TVA, three being in operation and three under construction. Wheeler Dam is located in northern Alabama fifteen miles downstream from the present Wilson Dam Station. The dam is a low head installation and provides for a maximum head of forty-eight feet. It will have considerable storage space available above the dam. The Norris Dam is primarily a storage unit, releasing water at low flows in the Tennessee River so as to increase the flow at the Wheeler and Wilson Dams. This adds materially to the power of the Tennessee system.—*Baldwin-Southwark.*

MACHINING WORLD'S LARGEST BEARING

Believed to be the largest journal bearing ever made, the three hundred and seventeen thousand-pound "horseshoe" bearing which will carry the million-pound load of the world's largest telescope atop Mt. Palomar, California, is being machined at the East Pittsburgh plant of the Westinghouse Electric & Manufacturing Co. This giant instrument, one of the most important technical projects of all history, is expected to enable astronomers to peer one billion light years into space.

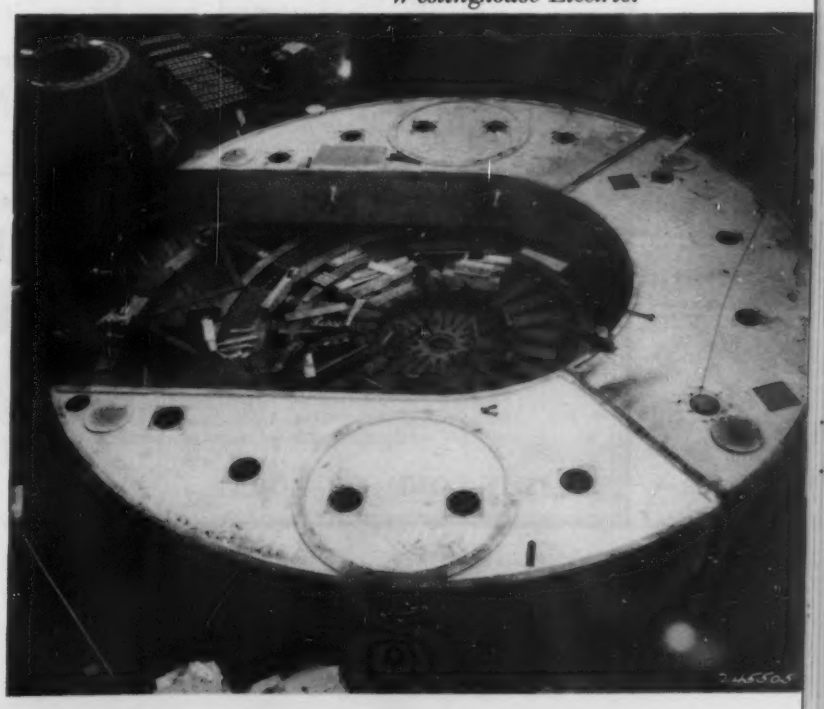
Because of its unusual size, the bearing was made in three sections at the Westinghouse Turbine Division at South Philadelphia, being partially machined there before it was shipped on flat cars to East Pittsburgh.

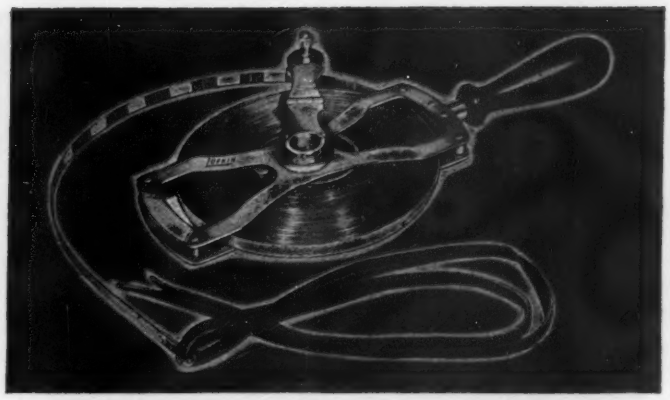
The bearing itself is forty-six feet across and fifty-three inches thick, sixty-three hours being required to machine one-sixteenth of an inch off its face. It is sprung out of shape while being machined so that it will assume the form of a perfect circle under the weight of the telescope. Engineering calculations are so exact that its final position will be within five-thousandths of an inch of a perfect circle.

When hoisted into position on a steel base at the telescope site, the bearing will rest on two steel oil pads through which oil will be pumped at a pressure of two hundred and fifty pounds per square inch. Despite the fact that the telescope and its supporting structure will have the proportions of a six-story building, the friction between the bearing and the oil pads will be so slight that an electric motor of only one hundred and sixty-five thousandths of a horsepower could turn it. The friction will be six hundred times less than that of a conventional type bearing.

Designers of the telescope support selected the horseshoe shaped bearing to enable the sixty-foot telescope tube, housing the two-hundred-inch reflecting mirror, to swing easily between the sides of the horseshoe for an unobstructed view from the polar to the southern horizons. The ability of the bearing to turn freely on its oil pads will permit the tube to be sighted from the eastern to the western horizons.

—*Westinghouse Electric.*





SWITCH TO LUFKIN
for a longer-wearing Tape

When you choose a Lufkin "Michigan" chain tape you've chosen a tape that's built for hard service. The markings are deeply stamped in long-wearing Babbitt metal. The sturdy dull-nickeled reel effectively resists weather and wear. Every part of a Lufkin "Michigan" tape—frame, tape-line, handle and even the brass end-clips and leather thongs are designed and built for hard use. And records of their performance prove they can "take it."
See your nearest dealer or write for free illustrated catalog No. 12.

NEW YORK 106 Lafayette St | THE LUFKIN RULE CO SAGINAW, MICHIGAN | Canadian Factory WINDSOR, ONT.
TAPES — RULES — PRECISION TOOLS

E. D. ABBOTT COMPANY
PRINTERS
181 Massachusetts Avenue, Boston, Mass.
Kenmore 4051 and 3277

WEATHER FORECASTING

(*Continued from page 65*)

cut and dry the hay before getting it into the barn. But on the other hand, if an easterly spell with rain and damp weather is coming, then his energies may be changed over to planting or transplanting; or if the weather is to be wet for a few days, he may confine his labors to inside work until the weather becomes settled. If the weather changes and extends for a lengthy period in any way, such as either a prolonged dry or wet spell, the farmer has to turn to and exert his efforts in preventing some of the ill effects that are brought on by such conditions. So without dispute, the life of the farmer is a busy one, and is wholly dependent upon practically every change of the weather.

There is nothing more true than the statement that the weather never satisfies everyone at the same time. One of the greatest disappointments to the majority of people is to have a rainy week-end during the summer months, for it is a time when everyone is seeking pleasure in the open after a week of toil. And if the weather has been hot during the week, thoughts are turned longingly for a pleasant week-end in the mountains or at the seashore. Hotel and innkeepers, as well as all concerned connected with summer businesses, are likewise looking forward to a week-end of fine weather which will enable them to make a few dollars and keep them at least out of debt by the end of the season. Everyone, from hot-dog stand proprietors to service station men, and particularly street railways and railroads plan a big rush for the week-end. So naturally, with such a large majority of seekers of both pleasure and week-end business, the plans made by all are so definite that any other kind of weather than bright sunshine and a smiling sky would be an utter impossibility. In other words, everyone is happy but the very small minority of those who depend upon the selling of rainy weather goods for their livelihood.

On the other hand, however, just as one of these big, planned-for week-ends arrives, instead of a clear blue sky with sunshine, suppose the day dawns gray with heavy clouds and threatening rain. If it is Satur-

(*Continued on page 73*)

When you want your car serviced by men who know how, coupled with the proper equipment, you will make no mistake in bringing it to us.

For years we have been rendering service to both members of the faculty and students at M. I. T.

Located near by at 306 Massachusetts Avenue.

We have live storage facilities for a limited number of cars for any who are interested.

RYAN & McMATH CO.

Kirkland 2020 — 306 MASSACHUSETTS AVENUE

SAMSON SPOT SASH CORD

Trade-Mark Registered U. S. Patent Office

Made of extra quality cotton yarn, carefully inspected, and guaranteed free from all imperfections of braid or finish.
The colored spots are our trade-mark, used only with this quality.
We make braided cord of all sizes, kinds, and colors for all purposes, including sash cord, clothes lines, trolley cord, signal cord, arc lamp cord, and many special cords for special purposes; also cotton twines.
CATALOGUE AND SAMPLES GLADLY SENT ON REQUEST

SAMSON CORDAGE WORKS — 89 Broad Street, Boston 9, Mass.

WEATHER FORECASTING

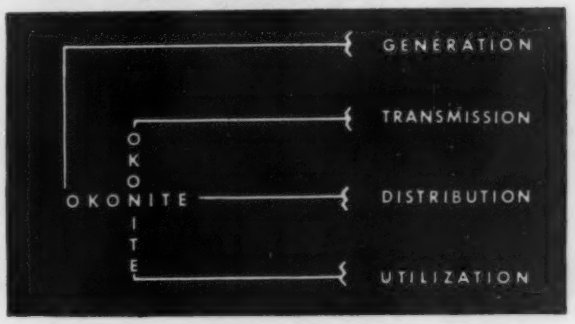
(*Continued from page 72*)

day, the telephone calls begin pouring into the writer's office to seek information as to how long the weather will be on its bad behavior. And if rain settles down with an easterly to northeasterly wind and things look bad from every angle, telephone calls sharply increase, not only to the weather man, but among numberless gatherings who have previously made plans for a week-end at one place or another. The nature of these telephone calls will either be to cancel engagements, or the call will refer to the big word "if," which will depend, perhaps, on a favorable or unfavorable turn in the weather.

In the meantime, the store salesman or owner begins to cheer up, when he notices an increase in his business as dripping customers come in to purchase raincoats, umbrellas and rubbers. In other words, rainy weather salesmen get a scoop on some of the money that the hot-dog seller expected to get on the following day. And if the storm continues over into Sunday and holds with a steady downpour and brisk easterly and northeasterly winds throughout the day, a very sharp decline in highway traffic takes place. Highway traffic will drop frequently from 50 to 75 per cent, with a corresponding drop in connection with all doing a summer week-end business.

And so it goes; there is nothing that has a more blanketing effect on humanity than the weather. No matter how large or small the business may be, or how young or old an individual may be, the weather is bound to create an effect to a greater or lesser degree.

THE 4-Ø ELECTRICAL SYSTEM



Okonite Wires and Cables are designed for every condition of use in each of these phases of any electrical system.

A 220,000-volt transmission cable or the smallest control wire may be the vital link in the chain, and seven laboratories in the Okonite factories provide the testing facilities that insure equivalent strength in each link.

There are many bulletins available on Okonite products that will help in solving problems involving insulated conductors.

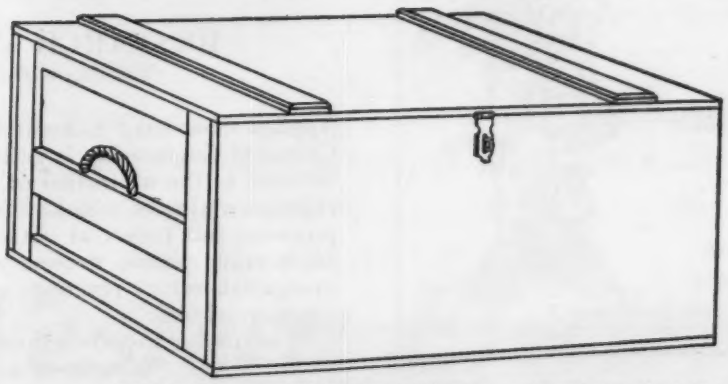
THE OKONITE COMPANY
Founded 1878

Executive Office OKONITE **Passaic, New Jersey**

PACKING CASES

THREE STYLES TWO SIZES

SHIPPING TAGS



PADLOCKS
Large Assortment

PLAIN CASES
Covers Nail On for Shipping

HINGED COVER HASP — ROPE HANDLES
For Shipping and Storage
***Also* SAME AS ABOVE — WITHOUT HANDLES**

TECHNOLOGY STORE
THE COOP

Perfect in **FORM**

Properly used, the dependable Plastic Powders of today insure perfect form in the finished product. That means maintenance of an unvarying and accurate temperature in the mold. You can do this easily, quickly and with certainty, if you use a Cambridge Mold Pyrometer. It is rugged, takes but a few seconds of a molder's time and can be relied upon always. Powder manufacturers recommend it.

Cambridge Instrument Co., Inc.
3732 Grand Central Terminal
New York City

CAMBRIDGE
Mold—Surface—Needle
PYROMETERS

BUFF
TRADE MARK TRADE MARK

Superior
Surveying Instruments

Buff & Buff Mfg. Co.
Jamaica Plain, Mass.
Telephone JAMaica 0370
Write For New Catalogue
A Souvenir Plumb Bob sent gratis to Civil Engineers.

ROCKET ENGINEERING

(*Continued from page 57*)

rocket jet at moderate vehicle speeds, two plans have been suggested. One is the augmenter, in which the rocket blast acts like the steam jet in an ejector to draw a large amount of air into a wide nozzle, heat it, and expel it with moderate velocity. A disadvantage of this method is gas shock, which occurs when a high-speed stream of gas impinges on a low-speed stream, this action producing an unavoidable loss of energy. The other plan is to use the blast to drive a turbine. The objection has been raised with this plan that no blades can withstand the intense heat of the jet. This objection does not seem to hold, however, as the blades are in the blast for but a short fraction of a whole revolution of the turbine. Perhaps the chief reason why the writer leans toward the turbine method is that a small, simple turbine actually worked in an oxygen-gasoline rocket blast, in a test made by him several years ago. Both of these methods of making the rocket adaptable to low-speed vehicles offer promising fields for further study, and should be of even more immediate application to transportation than purely jet-type propulsion. They constitute, in other words, the transitional step between engine and propeller propulsion, and pure jet propulsion. It may be added that the combustion chambers now used in developing the meteorological rocket are of practical size for use with direct reaction or with turbines, as they produce thrusts of several hundred pounds.

The aspect of the rocket which undoubtedly appeals most to the imagination is its possible use for flights outside the earth's atmosphere. Interest in this aspect has, in fact, given rise to various rocket and interplanetary societies throughout the world. As in many radically new developments, so much emphasis has been placed in the early stages on the ultimate possible achievements that the public comes to believe these must be within easy reach. Actually, in nearly all such engineering developments, progress must be made one step at a time, and the first step in this case is the meteorological or sounding rocket.

RESEARCH IN REVIEW

(*Continued from page 69*)

Applied Chemistry Laboratory of the Department of Chemical Engineering is actively carrying on research directed to the utilization of these hydrocarbons. The experimental work is not aimed at the discovery of new processes but rather at obtaining data on the various engineering phases necessary to carry out the well-known laboratory reactions of organic chemistry on a commercial scale.

Controlling these reactions is one of the most impor-

(*Continued on page 76*)

STEEL

HOT ROLLED **COLD ROLLED** **STRUCTURAL**

GENUINE NORWAY IRON

STAHLEKER STEEL CORPORATION

66 BINNEY STREET, KENDALL SQUARE, CAMBRIDGE **TELEPHONE TROWBRIDGE 1440**

Much has been said about the desirability of lower prices in the economic structure. It has always seemed to me that the Western Electric-Bell System relationship offers one interesting solution of this problem.

PRESIDENT

In the Public Interest

If a business did not need to seek or promote its market,

If its customers were fellow members in the same corporate system,

If their orders were consolidated so that economical production could be achieved,

Then—manufacturing could be conducted most efficiently and sales made without selling expense and without credit loss.

That exactly describes Western Electric's position in the Bell System, and the economies resulting from this arrangement are passed along to the telephone companies in the form of lower prices.

Thus Western Electric contributes its part in making Bell telephone service economical, and justifies its place in the Bell System as in the public interest.

Western Electric

BELL SYSTEM SERVICE
IS BASED ON
WESTERN ELECTRIC QUALITY

As Modern as Tomorrow

Simplex-ANHYDREX deproteinized rubber insulation is a perfect example of the value of research to industry. The Simplex research engineers strove for many years to find a rubber insulation that would not absorb harmful quantities of water.

They finally found it and now all industry can share the results of this research by specifying and buying wires and cables insulated with Simplex-ANHYDREX, the low water absorption insulation made with deproteinized rubber.

It does not need the protection of a lead sheath thus making the completed cable lighter and easier to handle and install.

SIMPLEX WIRE & CABLE CO.
79 Sidney Street, Cambridge, Mass.

RESEARCH IN REVIEW

(*Continued from page 74*)

tant problems that confront the chemical engineer working in this field. This is particularly true of the hydrocarbons produced by cracking petroleum, since the gases contain a mixture of paraffins and olefines, together with hydrogen, hydrogen sulfide, diolefines and similar constituents. The olefines in such a mixture are well suited as raw materials, because of their reactivity; however, the complexity of the mixture gives a variety of products and leads to side reactions. It is therefore desirable to separate the gas into its various constituents.

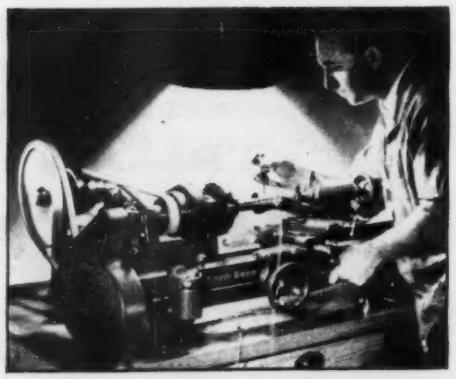
The separation and concentration of these olefines from each other and the accompanying paraffins is one of the most difficult problems relative to their utilization. In fact, the cost of this operation is often so great as to seriously limit the economical utilization of these olefines. Experimental work on this separation is being carried out in a study of low-temperature high-pressure rectification and in investigating the possibility of utilizing special chemical absorbents for the olefines.

From a chemical viewpoint, the following phases of olefine utilization are being studied:

1. The equilibrium and the rate of reaction in the direct hydration of olefines to alcohols, since this class of compounds constitute one of the most important raw materials for further chemical reactions. Data so far obtained indicate that dilute mineral acids are very active catalysts for hydration.

2. Work on the polymerization of the lower olefines indicates that it is possible to control the reaction to give polymers of either twice or three times the molecular weight of original olefines. These polymers have excellent anti-knock properties as motor fuel and can be made into aviation fuel of premium quality.

3. The direct oxidation of these lower hydrocarbons offers one of the most promising fields of endeavor. However, the reaction is difficult to control and in general the variety of products is so large that the process is of little commercial importance at present. Recent work indicates that it is possible to activate certain portions of the hydrocarbon molecule and subsequent oxidation is then concentrated primarily on the activated portion and side reactions occur to only a minor extent.



Illustrated above is the New 1938 Model 9" x 3' South Bend WORKSHOP Motor Driven Precision Back Geared Screw Cutting Engine Lathe, price $117., F. O. B. South Bend, Indiana.

More than 39 practical attachments available for this lathe.

See this and other sizes and models demonstrated at Boston distributors

THE MACKENZIE MACHINERY COMPANY
36 OLIVER STREET, BOSTON, MASS.
Phone Liberty 3525 Open Saturdays until 3 P. M.

Homes should be rated by what they can DO

HORSEPOWER of a house? It sounds odd—but homes are modern or not according to the amount of work they can do electrically. And when you use a kilowatt-hour of electricity, it has done just about as much work as a horse could do in an hour — provided a horse could sweep, cook, do the washing and ironing, provide light and refrigeration, tend the furnace, wind the clock, and furnish entertainment that varies from Pagliacci to Charlie McCarthy, according to your mood.

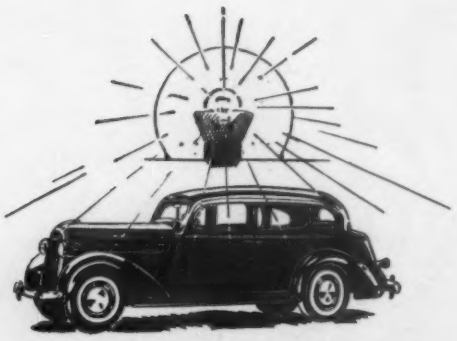
Electricity will do all these things and more. But in building, buying, or renting, it is important to see that the proper groundwork is laid for its use. Wiring should be ample, with plenty of outlets. Circuits should have modern protection. Even if you cannot take complete advantage of electricity today, plan for its wider use in the days to come.

By giving only the same attention to its electrical system that you give to its room arrangement, heating, and decoration, you can make your entire home a busy servant. A servant that will bring you comfort, leisure, health and pleasant living for only a few cents a day. A servant that will be even more efficient using Westinghouse apparatus and appliances.

Westinghouse

The name that means everything in electricity

G-E *Campus News*



18 INCHES OF SUNLIGHT

A 50,000-WATT General Electric MAZDA lamp, a foot and a half in diameter, was recently installed in the Styling Section of the General Motors Corporation at Detroit. This lamp, the first of its size to be used commercially, is utilized to simulate sunlight on automobiles on display. Previous lighting not only was inadequate, but produced distracting reflections on the car bodies.

By means of a G-E thyratron reactor control similar to devices used to dim lights in many large theaters, the light from the lamp can be varied from full brilliance to a black-out.

Many such practical applications as this are the culmination of group effort. That is why General Electric Test men of today and yesterday are always to be found contributing their part to General Electric's progress.

FOR OUTSTANDING ACHIEVEMENT

EACH year General Electric honors those employees who have done outstanding work in their fields as provided in the Charles A. Coffin Foundation. This year 40 men were chosen—15 of them college graduates:

Adelbert Alexay, Polytechnic Institute of Budapest, '11; *Alexander Babillis, Rose Polytechnic Institute, '28; *T. M. Berry, Kansas State College, '27; Michael Broverman, Tri-State College, '22; F. E. Carlson, University of Michigan, '25; *S. B. Crary, Michigan State College, '27; R. E. Farnham, Case School of Applied Science, '17; J. W. Gilchrest, Cooper Union, '08; *A. H. Lauder, University of Wyoming, '22; *Domenico Martignone, Central Technical College of London, '01; *F. N. Neal, University of Utah, '31; *D. R. Shoults, University of Idaho, '25; F. C. Smith, Drexel Institute, '06; *L. A. Umansky, Polytechnical Institute of Petrograd, '15; R. E. Worstell, Purdue University, '25.

If any one generalization could be made to cover the qualifications for this award, it would probably hinge upon the extent to which an employee took advantage of his opportunities, beyond the ordinary routine of his work to achieve an outstandingly worth-while result.

**Former G-E Test man*

LIGHTNING GUIDER

AFTER three years of photographing natural lightning striking the Empire State Building in New York City, it was determined that many lightning strokes which appear to crash from the clouds to the ground actually are met part way by a small flash, originating from the earth, which guides the stroke to its destination.

In addition, laboratory tests, under the direction of Karl B. McEachron, graduate of Purdue University and former G-E Test man, indicate that discharges between points and planes always begin at the point. The Empire State represents to the cloud a tremendous needle on the earth's surface. Thus the guiding flash will originate from the tower and shoot upward.

Destruction occurs when a lightning bolt contacts a high-resistance area. Lightning conductors prevent this by grounding the discharge in an area of low ground resistance, and the lightning control on the Empire State affords a protective area within a radius of approximately one mile.

GENERAL ELECTRIC

90-57DH

THE MURRAY PRINTING COMPANY
CAMBRIDGE, MASSACHUSETTS